Warren County School District

PLANNED INSTRUCTION

COURSE DESCRIPTION

Course Title: Advanced Placement Physics 2

Course Number: 00357

Course Prerequisites: Appropriate algebra based coursework

Course Description:
AP Physics 2 is an algebra-based, introductory college-level physics course that explores topics such as fluid statics and dynamics; thermodynamics with kinetic theory; PV diagrams and probability; electrostatics; electrical circuits with capacitors; magnetic fields; electromagnetism; physical and geometric optics; and quantum, atomic, and nuclear physics. Through inquiry-based learning, students will develop scientific critical thinking and reasoning skills**.**

Suggested Grade Level: Grades 11-12

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 #: ISBN #: 10:0-13-344768-5 teacher edition
13:978-0-13-344768-2 student edition

Copyright Date: 2014
Date of WCSD Board Approval:

Title: Conceptual Physics
Publisher: Pearson
ISBN #: 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

The AP Physics 2 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 AP Physics 2

UNIT 1. ELECTROSTATICS [CR2c]

- Electric Force
- Electric Field
- Electric Potential

Big Ideas 1, 2, 3, 4, 5
Learning Objectives: 1.B.1.1, 1.B.1.2, 1.B.2.2, 1.B.2.3, 1.B.3.1, 2.C.1.1, 2.C.1.2, 2.C.2.1, 2.C.3.1, 2.C.4.1, 2.C.4.2, 2.C.5.1, 2.C.5.2, 2.C.5.3, 2.E.2.1, 2.E.2.2, 2.E.2.3, 2.E.3.1, 2.E.3.2, 3.A.2.1, 3.A.3.2, 3.A.3.3, 3.A.3.4,

3.A.4.1, 3.A.4.2, 3.A.4.3, 3.B.1.3, 3.B.1.4, 3.B.2.1, 3.C.2.1, 3.C.2.2, 3.C.2.3, 3.G.1.2, 3.G.2.1, 4.E.3.1, 4.E.3.2, 4.E.3.3, 4.E.3.4, 4.E.3.5, 5.A.2.1, , 5.B.2.1, 5.C.2.1, 5.C.2.2, 5.C.2.3

UNIT 2. ELECTRIC CIRCUITS [CR2d]

- Electric resistance
- Ohm's Law
- DC circuits with resistors only
- Kirchhoff's Laws
- Series, parallel and series-parallel circuits
- Capacitance
- DC circuits with resistors and capacitors

Big Ideas 1, 4, 5

Learning Objectives: 1.E.2.1, 4.E.4.1, 4.E.4.2, 4.E.4.3, 4.E.5.1, 4.E.5.2, 4.E.5.3, 5.B.9.4, 5.B.9.5, 5.B.9.6, 5.B.9.7, 5.B.9.8, 5.C.3.4, 5.C.3.5, 5.C.3.6, 5.C.3.7

UNIT 3. MAGNETISM AND ELECTROMAGNETIC INDUCTION [CR2e]

- Magnetic field
- Magnetic force on a charged particle
- Magnetic force on a current-carrying wire
- Magnetic flux
- Electromagnetic induction: Faraday's Law
- Lenz's law
- Motional *emf*

Big Ideas 1, 2, 3, 4

Learning Objectives: 2.C.4.1, 2.D.1.1, 2.D.2.1, 2.D.3.1, 2.D.4.1, 3.A.2.1, 3.A.3.2, 3.A.3.3, 3.A.4.1, 3.A.4.2, 3.A.4.3, 3.C.3.1, 3.C.3.2, 4.E.1.1, 4.E.2.1

UNIT 4. THERMODYNAMICS [CR2a]

- Kinetic theory
- Ideal gases
- First law of thermodynamics
- Thermodynamic processes and PV diagrams
- Heat engines
- Carnot cycle
- Efficiency
- Second law of thermodynamics: entropy

Big Ideas 1, 4, 5, 7

Learning Objectives: 1.E.3.1, 4.C.3.1, 5.A.2.1, 5.B.4.1, 5.B.4.2, 5.B.5.4, 5.B.5.5, 5.B.5.6, 5.B.6.1, 5.B.7.1, 5.B.7.2, 5.B.7.3, 7.A.1.1, 7.A.1.2, 7.A.2.1, 7.A.2.2, 7.A.3.1, 7.A.3.2, 7.A.3.3, 7.B.1.1, 7.B.2.1

UNIT 5. FLUIDS [CR2b]

- Density
- Pressure: atmospheric and fluid pressure
- Pascal's principle
- Buoyant force
- Archimedes' principle
- Flow rate
- Continuity equation
- Bernoulli's principle

Big Ideas 1, 3, 5

Learning Objectives: 1.E.1.1, 1.E.1.2, 3.C.4.1, 3.C.4.2, 5.B.10.1, 5.B.10.2, 5.B.10.3, 5.B.10.4, 5.F.1.1

UNIT 6. GEOMETRIC AND PHYSICAL OPTICS [CR2f]

- Reflection
- Image formation by flat and curved mirrors
- Refraction and Snell's Law
- Image formation by thin lenses
- Interference and diffraction
- Double slit, single slit and diffraction grating interference
- Thin film interference

Big Idea 6
Learning Objectives: 6.A.1.2, 6.A.1.3, 6.A.2.2, 6.B.3.1, 6.C.1.1, 6.C.1.2, 6.C.2.1, 6.C.3.1, 6.C.4.1, 6.E.1.1, 6.E.2.1, 6.E.3.1, 6.E.3.2, 6.E.3.3, 6.E.4.1, 6.E.4.2, 6.E.5.1, 6.E.5.2, 6.F.1.1, 6.F.2.1

UNIT 7. QUANTUM PHYSICS, ATOMIC AND NUCLEAR PHYSICS [CR2g]

- Atoms, atomic mass, mass number and isotopes
- Atomic energy levels
- Absorption and emission spectra
- Models of light: wave and particle
- Photoelectric effect
- DeBroglie wavelength
- Wave function graphs
- Mass-energy equivalence
- Radioactive decay: alpha, beta and gamma decay
- Half life
- Conservation of nucleon number: fission and fusion

Big Ideas 1, 3, 4, 5, 6, 7
Learning Objectives: 1.A.2.1, 1.A.4.1, 1.C.4.1, 1.D.1.1, 1.D.3.1, 3.G.3.1, 4.C.4.1, 5.B.8.1, 5.B.11.1, 5.C.1.1, 5.D.1.6, 5.D.1.7, 5.D.2.5, 5.D.2.6, 5.D.3.2, 5.D.3.3, 5.G.1.1, 6.F.3.1, 6.F.4.1, 6.G.1.1, 6.G.2.1, 6.G.2.2, 7.C.1.1, 7.C.2.1, 7.C.3.1, 7.C.4.1

LABORATORY INVESTIGATIONS AND THE SCIENCE PRACTICES

The AP Physics 2 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**	**SCIENCE PRACTICES [CR6b]**

	(Investigation identifier: Guided Inquiry: **GI** Open Inquiry: **OI**) **[CR6b]**	
UNIT 1. ELECTROSTATICS	**1. Electrostatics Investigations (GI)** To investigate the behavior of electric charges, charging processes and the distribution of charge on a conducting object.	1.1, 3.1, 4.1, 4.2, 5.1, 5.3, 6.1, 6.2, 6.4, 7.2
	2. The Electroscope (GI) To make qualitative observations of the behavior of an electroscope when it is charged by conduction and by induction.	1.1, 3.1, 4.1, 4.2, 5.1, 5.3, 6.1, 6.2, 6.4, 7.2
	3. Coulomb's Law (OI) To estimate the net charge on identical spherical pith balls by measuring the deflection (angle and separation) between two equally charged pith balls.	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
	4. Electric Field and Equipotentials (GI) To map equipotential isolines around charged conducting electrodes painted with conductive ink and construction of isolines of electric fields.	1.1, 1.2, 1.4, 3.1, 4.1, 4.2, 4.3, 5.1, 6.1, 6.2, 6.4, 7.2
UNIT 2. ELECTRIC CIRCUITS	**5. Resistance and Resistivity (OI)** To explore the microscopic and macroscopic factors that influence the electrical resistance of conducting materials. Students will investigate how geometry affects the resistance of an ionic conductor using Play-Doh™	1.2, 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
	6. DC Circuits: Brightness (GI) To make predictions about the brightness of light bulbs in a variety of DC circuit configurations (series, parallel and series-parallel) when some of the bulbs are removed.	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.2, 6.4, 7.2
	7. DC Circuits: Resistors (OI) To investigate the behavior of resistors in series, parallel and series-parallel DC circuits. The lab includes measurements of currents and potential differences.	1.2, 1.4, 32.1, 2.2, .1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.2, 6.4, 7.2
	8. RC Circuits: Resistors and Capacitors (GI) This investigation consists of two parts: ▪ An observational experiment where the students make qualitative descriptions of the charging and discharging of a capacitor. ▪ To investigate the behavior of resistors in a series-parallel combination with a capacitor in series. Their investigation includes measurement of currents and potential differences.	1.2, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.2, 6.4, 7.2
UNIT 3. MAGNETISM AND	**9. Magnetic Field of the Earth (GI)**	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

ELECTROMAGNETIC INDUCTION	To measure the horizontal component of the Earth's magnetic field using a solenoid and a compass.	
	10. Magnetic Force on a Current-Carrying Wire (GI) To determine the magnitude and direction of the magnetic force exerted on a current-carrying wire.	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	11. Electromagnetic Induction (GI) The students move a bar magnet in and out of a solenoid and observe the deflection of the galvanometer. They examine the effects of a changing magnetic field by observing currents induced in a solenoid and determine whether the observations agree with the theory of electromagnetic induction and Lenz' law.	1.1, 1.2, 1.4, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.2, 6.4, 7.2
UNIT 4. THERMODYNAMICS	**12. Gas Laws (OI)** To verify the relationships between pressure, temperature and volume of a gas (air).	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
	13. Thermal Conductivity (GI) To determine the thermal conductivity of a material by comparing the difference in temperature across one material to the difference in temperature across a second material of known thermal conductivity.	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 6.1, 6.2, 6.4, 7.2
	14. Heat Engine (GI) To determine how the work done by an engine that raises mass during each of its cycles is related to the area enclosed by its *P*-*V* graph.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 6.1, 6.2, 6.4, 7.2
	15. Efficiency of a Hair Dryer (GI) To determine the efficiency of a hair dryer as it dries a wet towel.	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 6.1, 6.2, 6.4, 7.2
UNIT 5. FLUIDS	**16. Archimedes' Principle (OI)** To determine the densities of a liquid and two unknown objects by using the method that is attributed to Archimedes.	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
	17. Torricelli's Theorem (GI) To determine the exit velocity of a liquid and predict the range attained with holes at varying heights using a clear 2 L plastic bottle.	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
	18. Water Fountain Lab (GI) The students design an investigation to determine: ▪ Exit angle and exit speed of the water ▪ Maximum height of water ▪ Radius of the fountain's exit hole ▪ Flow volume rate	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
UNIT 6. GEOMETRIC AND PHYSICAL OPTICS	**19. Reflection (GI)** Students design an investigation to answer the following question: "Are there any patterns in	1.1, 1.2, 1.3, 1.4, 3.3, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

	the way plane mirrors and curved mirrors reflect light?"	
	20. Concave Mirrors (OI) This investigation has two parts: ▪ To determine the focal length of a concave mirror ▪ To determine two locations where a magnified image can be formed using a concave mirror.	1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.4, 7.2
	21. Index of Refraction (OI) To determine the index of refraction of an acrylic block.	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
	22. Lenses (OI) This investigation is divided into two parts: ▪ To directly determine the focal length of a converging lens directly ▪ To determine the focal length of a diverging lens by combining it with a converging lens.	1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.4, 7.2
	23. Double-Slit Interference and Diffraction (OI) This lab activity consists of three parts where the students design each investigation: ▪ To determine the wavelength of a green laser using a double slit. ▪ The students apply the results of the previous experiment to predict the location of bright and dark fringes when a red laser of known wavelength is used. ▪ The students determine the spacing in a diffraction grating using either the green or the red laser.	1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.4, 7.2
UNIT 7. QUANTUM PHYSICS, ATOMIC AND NUCLEAR PHYSICS	**24. Spectroscopy (GI)** Students use a quantitative analysis spectroscope to analyze flame tests and spectrum tubes.	1.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	25. Photoelectric Effect (OI) The determine Planck's constant from data collected from a circuit with an LED color strip.	1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.4, 7.2
	26. Radioactive Decay and Half-Life (GI) In this investigation students simulate radioactive decay and determine half-life.	1.1, 1.2, 1.3, 1.4, 2.3, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 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)**:** successful completion of the final examination for the course with an 80% or better.

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