PREREQUISITES: concurrent enrollment in PreCalculus or higher math

ACADEMIC HONESTY: Angelo State University students shall maintain complete honesty and integrity in their academic pursuits. The University expects all students to engage in all academic pursuits in a manner that is above reproach and to maintain complete honesty and integrity in the academic experiences both in and out of the classroom. Also, all honor code and late work policies set forth by SAISD shall be adhered to, as well.

MATERIALS REQUIRED:
- 3-Ring Binder (1 ½ “ or larger)
- Binder Dividers
- Composition notebook for notetaking and reading assignments.
- College ruled lined paper
- Graph paper or engineering paper
- Graphing calculator, TI-82 or higher. (you can download a calculator app, but during class the phone may not be used. Students may use one of my class set calculators but only during the period.)
- Pencils, Black Ink Pens, Red Ink Pens, Colored Pencils
- Personal Electronic Devices – Our textbook has web access, as well as online homework assignments. These can be accessed on android and apple devices easily, as well as computers. There are public availability to technology through library computers.

Additional Materials:
These are materials that are optional, but we do need them for class. Every student is not required to bring every item. Please bring what you can.
- Kleenex
- Paper Towels
- Disinfecting Wipes
- 3x5” index cards

GRADING POLICY: Each nine-week grade will be based on 65% major including exams and major labs, 35% minor including daily work, quizzes, and small labs. Examinations will not be returned to the student to keep. Students may view and correct their graded exams during normal tutorial periods and exam corrections must be completed before the next unit test. Exams given during the last week of the grading period are not correctable but may be viewed.
HOMEWORK POLICY: Homework will be assigned on a regular basis and quizzes will be given over the homework. There will be a large portion of homework assignments that will be assigned online and required to be completed online. The school has multiple computers available before school, at lunch, and after school in the library for those students who do not have access. The county library has the same access with extended hours. Some homework assignments will be cumulative in nature, and have an extended due date. No late work will be accepted. Homework is your opportunity to practice and apply concepts, and it must be completed for success in this class.

LABORATORY INVESTIGATIONS: The AP/Dual Credit Physics 2 course devotes over 25% of the time to laboratory investigations. The laboratory component of the course allows the students to demonstrate the seven science practices laid out by College Board through a variety of investigations in all of the foundational principals. These investigations will include guided inquiry, as well as open inquiry where the student will design their own investigation of a physical phenomenon. Students are expected to record their observations, data and data analyses. Students will be given lab quizzes over the concepts covered in the labs and the types of data analysis required.

MAKE-UP POLICY: The student is allowed to make up work for all absences in accordance with district-adopted policy (See student handbook). If you know you are going to be absent or leave school early, you should check with the teacher to see if there are any assignments/quizzes to be taken and make arrangements for make-up. This applies to school sponsored activities, doctor’s appointments, out of town trips, etc. Failure to make up this work in a timely manner will result in the work being considered late and result in a zero.

TEACHERS TUTORIAL TIMES: I will be available for tutorials multiple times during the week. Thursday during tutorial period, I will always be in class to assist students. I will be available before school on Wednesdays and Thursdays and after school on Wednesdays, as well. Students are encouraged to attend tutorials any time they experience any difficulty completing an assignment or in preparing for a test. It is best to work ahead and not put off assignments until the day they are due. Certainly, tutorials are strongly recommended at any time student performance drops below 80%.

PARENTAL COMMUNICATIONS: It is vital that an open line of communication be maintained. My gradebook has web access. Please check it and let me know if you have any questions. EMAIL is my preferred and quickest method of communication for any questions or concerns, but feel free to message me through the Remind app as well. Please include email addresses so that I may contact you concerning your students’ progress in a timely manner. Throughout the day it is rare for me to have any privacy to have a conversation during the school day. I am able to communicate quickly and privately using email, even if I have students in the room.

TEXTBOOK AND RESOURCES

Final Examination for Angelo State Dual Credit AND AP will be May 1-2, 2015 during scheduled class

All SAISD Advanced Academic policies will be strictly adhered to. Please make sure you are fully aware of all these policies.
THIS IS TO CERTIFY THAT I/WE HAVE RECEIVED A COPY OF THE COURSE SYLLABUS AND THE REQUIREMENTS FOR AP/DC PHYSICS 2. I UNDERSTAND THAT LATE WORK WILL NOT BE ACCEPTED.

STUDENT SIGNATURE: ________________________________

STUDENT’S PRINTED NAME: __________________________ PERIOD: ______

STUDENT EMAIL ADDRESS: ____________________________

PARENT/GUARDIAN NAME: ______________________________

PARENT/GUARDIAN SIGNATURE: ____________________________

PARENT E-MAIL ADDRESS: ________________________________

Parent Cell Phone(s): ____________________  Parent Home Phone(s): ____________________
**Course Description**

**TEXTBOOK**

**TEACHING RESOURCES**


**Teaching Strategies**
AP® Physics 2 is equivalent to most college-level introductory physics courses with a focus on the following topics: fluid statics and dynamics, thermodynamics, PV diagrams and probability, electrostatics, electrical circuits with capacitors, magnetic fields, electromagnetism, physical and geometric optics, and other topics in modern physics. AP Physics 1 should be taken before this course, which covers traditional mechanics and other important introductory topics. Students who took PreAP Physics their junior year should be well suited for this course.

AP® Physics 2 is organized around six big ideas that bring together the fundamental science principles and theories of general physics. These big ideas are intended to encourage students to think about physics concepts as interconnected pieces of a puzzle. The solution to the puzzle is how the real world around them actually works. The students will participate in inquiry-based explorations of these topics to gain a more conceptual understanding of these physics concepts. Students will spend less of their time in traditional formula-based learning and more of their effort will be directed to developing critical thinking and reasoning skills.

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 will be using a range of lab equipment including, but not limited to probeware technology in data acquisition, large scale lab equipment, technology integrated lab equipment, simple hands on activities, and online laboratory simulations. In the classroom they will be using graphing calculators and digital devices for interactive simulations, physlet based exercises, collaborative activities and formal assessments. Students will also be using an online homework, tutorial, and assessment tool, Mastering Physics.

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**Grading Percentages:**
Major – 65%
Minor – 35%

All SAISD Advanced Academic policies will be strictly adhered to. Please make sure you are fully aware of all these policies.

CR1—Students and teachers have access to college-level resources including college-level textbooks and reference materials in print or electronic format.
Physics Outline of Units with Timelines

I. Optics - weeks 1-4
   Big Idea 6 [CR2f]
   A. Physical Optics
      1. The electromagnetic spectrum
      2. Interference
      3. Diffraction
      4. Thin films
   B. Geometric Optics
      1. Reflection and refraction
      2. Images formed by mirrors
      3. Images formed by lenses

II. Fluid Mechanics - weeks 5-7
   Big Ideas: 1, 3, and 5 [CR2b]
   A. Density and Pressure
      1. Density and specific gravity
      2. Pressure as a function of depth
      3. Pascal’s principle
   B. Buoyancy
      1. Buoyant force
      2. Archimedes’ principle
   C. Fluid flow continuity
   D. Bernoulli’s Equation

III. Thermal Physics - weeks 8-11
   Big Ideas: 1, 4, 5, and 7 [CR2a]
   A. Temperature and Heat
      1. Mechanical equivalent of heat
      2. Heat transfer and thermal expansion
   B. Kinetic Theory
      1. Ideal gases
      2. Gas laws
   C. Thermodynamics
      1. Thermodynamic processes and PV diagrams
      2. Zeroth, First, and Second Law of Thermodynamics

IV. Atomic and Nuclear Physics - weeks 12-14
   Big Ideas: 1, 3, 4, 5, 6, and 7 [CR2g]
   A. Atomic Physics and Quantum Effects
      1. Discovery of the Electron and Atomic Nucleus
      2. Photons and the Photoelectric Effect
      3. Bohr Model
      4. De Broglie Wavelength
      5. Production of X-rays
      6. Compton Scattering
v. Electricity - weeks 18-22
Big Ideas: 1, 2, 3, 4, and 5 [CR2c] [CR2d]
A. Electrostatics
   1. Coulomb’s Law
   2. Electric Field
   3. Electric Potential
   4. Electrostatics with Conductors
B. Capacitors
   1. Capacitance
   2. Energy and charge stored
   3. Parallel plates
C. Electric Current
   1. Definition of direction of current
   2. Ohm’s Law
   3. Resistance and Resistivity
   4. Power
D. DC Circuits
   1. Schematic diagrams/Kirchhoff’s Laws
   2. Resistors
   3. Capacitors
   4. Terminal voltage and internal resistance
   5. Steady-state RC circuits

vi. Magnetism – weeks 23-26
Big Ideas: 2, 3, and 4 [CR2e]
A. Magnetostatics
   1. Magnetic field
   2. Forces on moving charges
   3. Forces on a current-carrying wire
   4. Magnetic field of current-carrying wires
B. Electromagnetism
   1. Magnetic flux
   2. Faraday’s Law and Lenz’s Law
   3. Induced emf and induced current

vii. Modern Physics and Review for AP Exams - weeks 27-32
Central HS  AP Physics 2  C. Stephens

Laboratory Investigations and 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 outcome. 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 report. 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]

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<td></td>
<td>To investigate the behavior of electric charges, charging processes, and the distribution of charge on a conducting object.</td>
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<th>2. The electroscope (GI) [CR6b]</th>
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<td>To make qualitative observations of the behavior of an electroscope when it is charged by conduction and by induction.</td>
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<th>3. Coulomb’s Law</th>
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<td>To estimate the net charge on identical spherical pith balls by measuring the deflection (angle and separation) between two equally charged pith balls.</td>
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<th>4. Electric Field and equipotentials (GI) [CR6b]</th>
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<tr>
<td>To map equipotential isolines around charged conducting electrodes painted with conductive ink and construction of isolines of electric fields.</td>
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<tr>
<th>UNIT 2. Electric Circuits [CR6a]</th>
<th>5. Resistance and Resistivity (GI) [CR6b]</th>
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<tr>
<td></td>
<td>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™.</td>
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<th>6. DC Circuits: Brightness (GI) [CR6b]</th>
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<tr>
<td>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.</td>
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CR7 — The course provides opportunities for students to develop their communication skills by recording evidence of their research of literature or scientific investigations through verbal, written, and graphic presentations.

CR6a — The laboratory work used throughout the course includes a variety of investigations that support the foundational AP Physics 2 principles.

CR6b — The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.
### 7. DC Circuits: Resistors
To investigate the behavior of resistors in series, parallel, and series-parallel DC circuits. The lab includes measurements of currents and potential differences.

### 8. RC Circuits: Resistors and Capacitors (GI) [CR6b]
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.

### UNIT 3. Magnetism and Electromagnetic Induction [CR6a]

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<tr>
<th>9. Magnetic Field of the earth (GI) [CR6b]</th>
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<tr>
<td>To measure the horizontal component of the Earth’s magnetic field using a solenoid and a compass.</td>
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<th>10. Magnetic Force on a Current-Carrying Wire (GI) [CR6b]</th>
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<td>To determine the magnitude and direction of the magnetic force exerted on a current-carrying wire.</td>
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<tr>
<th>11. Electromagnetic Induction (GI) [CR6b]</th>
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<tr>
<td>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.</td>
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### UNIT 4. Thermodynamics [CR6a]

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<th>12. Gas Laws</th>
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<td>To verify the relationships between pressure, temperature, and volume of a gas (air).</td>
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<th>13. Thermal Conductivity (GI) [CR6b]</th>
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<td>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.</td>
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<th>14. Heat engine (GI) [CR6b]</th>
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<td>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.</td>
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<th>15. Efficiency of a Hair Dryer (GI) [CR6b]</th>
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<td>To determine the efficiency of a hair dryer as it dries a wet towel.</td>
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<td>UNIT 5. Fluids [CR6a]</td>
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|                       | 18. Water Fountain Lab (GI) [CR6b] | 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 |

| UNIT 6. Geometric and Physical Optics [CR6a] | 19. Reflection (GI) [CR6b] | Students design an investigation to answer the following question:  
"Are there any patterns in the way plane mirrors and curved mirrors reflect light?" |
|----------|--------------------------------|------------------------------------------------------------------------------|
|          | 20. Concave Mirrors (GI) [CR6b] | 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. |
|          | 21. Index of Refraction (GI) [CR6b] | To determine the index of refraction of an acrylic block. |
|          | 22. Lenses (GI) [CR6b] | This investigation is divided into two parts:  
  - To directly determine the focal length of a converging lens.  
  - To determine the focal length of a diverging lens by combining it with a converging lens. |
|          | 23. Double-slit Interference and Diffraction | 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. |
Instructional Activities

| UNIT 7. Quantum Physics, Atomic and Nuclear Physics [CR6a] | 24. spectroscopy (GI) [CR6b]  
Students use a quantitative analysis spectroscope to analyze flame tests and spectrum tubes. |
| --- | --- |
| 25. Photoelectric effect  
The determine Planck’s constant from data collected from a circuit with an LED color strip. |
| 26. Radioactive Decay and Half-Life (GI) [CR6b]  
In this investigation, students simulate radioactive decay and determine half-life. |

Throughout the course, the students engage in a variety of activities designed to build the students’ reasoning skills and deepen their conceptual understanding of physics principles. Students conduct activities and projects that enable them to connect the concepts learned in class to real world applications. Examples of activities are described below.

1. Simulation Activity
Students engage in activities outside of the laboratory experience that support the connection to more than one Learning Objective.

ACTIVITY: Quantum Wave Interference [CR3]
Description:
The PhET Quantum Wave Interference simulation (http://phet.colorado.edu/en/simulation/wave-interference) helps students to visualize the behavior of photons, electrons, and atoms as particles and as waves through a double-slit. The students work in small groups through a series of ‘experiments’ that confront students with the basic conflict between the wave model and particle model. The groups have to gather evidence that will allow them to justify how the double slit interference pattern is consistent with both the classical wave view and the photon view. After the class discussion, the students should be able to articulate how the wave view is related to the photon view. This activity is designed to allow students to apply the following Learning Objectives:

Learning objective 1.D.1.1  
The student is able to explain why classical mechanics cannot describe all properties of objects by articulating the reasons that classical mechanics must be refined and an alternative explanation developed when classical particles display wave properties.

Learning objective 6.G.1.1  
The student is able to make predictions about using the scale of the problem to determine at what regimes a particle or wave model is more appropriate.

CR3—Students have opportunities to apply AP Physics 2 learning objectives connecting across enduring understandings as described in the curriculum framework. These opportunities must occur in addition to those within laboratory investigations.
2. Real World Applications

ACTIVITY 1. Fluid Applications [CR4]

Description:
Students write a series of questions that they wonder about related to buoyancy and density in real world contexts. In teams of two, the students select one research question. They have two class periods to post their results of the research on a Google Doc. Each team presents their information and any sources of data found to the class. Sample questions are:

• How do metal ships float?
• Will a ship full of oil float differently than an empty ship?
• If an oil tanker develops a leak, why does it sink?
• How will a ship float in fresh water as opposed to salt water?
• How and why do hot air balloons work?
• Would hydrogen balloons float better than balloons filled with hot air?

Learning objective 1.e.1.1
The student is able to predict the densities, differences in densities, or changes in densities under different conditions for natural phenomena and design an investigation to verify the prediction.

Learning objective 1.e.1.2
The student is able to select from experimental data the information necessary to determine the density of an object and/or compare densities of several objects.

Learning objective 3.C.4.2
The student is able to explain contact forces (tension, friction, normal, buoyant, spring) as arising from interatomic electric forces and that they therefore have certain directions.

CR4—The course provides students with opportunities to apply their knowledge of physics principles to real world questions or scenarios (including societal issues or technological innovations) to help them become scientifically literate citizens.