PREREQUISITES: concurrent enrollment in PreAP Algebra II 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.

GRADING POLICY: Each six-week grade will be based on 65% examinations, 25% labs & quizzes and 10% daily work including homework. Examinations will not be returned to the student to keep. Students may view their graded exams during normal tutorial periods.

HOMEWORK POLICY: Homework will be assigned on a regular basis. There will be a large portion of homework assignments that will be assigned online and be required to be completed online. 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.

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 and after school on Thursdays, as well.

RESOURCES

TEXTBOOK

TEACHING RESOURCES


Throughout this document, you will see side notes referring to CR#. These are curricular requirements set forth for this course by College Board.

CR1—Students and teachers have access to college-level resources including college-level textbooks and reference materials in print or electronic format.

Final Examination for Angelo State Dual Credit will be May 9-10, 2018 during scheduled class

All SAISD Advanced Academic policies will be strictly adhered to. Please make sure you are fully aware of all these policies.
UNIT 0. DATA ANALYSIS AND MATHEMATICAL REPRESENTATIONS (2wks)
- Proper data collection and representation
- Algebraic representation of variables and isolation of variables
- Scientific Notation, system definition, problem solving and unit conversions
- Using Thermodynamics, Ideal Gas law, and Fluid Mechanics, apply the ideas of variable dependency and mathematical and unit representations.

UNIT 1. KINEMATICS [CR2a] (3-4 wks)
- Kinematics in one-dimension: constant velocity and uniform accelerated motion
- Vectors: vector components and resultant
- Kinematics in two-dimensions: projectile motion

UNIT 2. DYNAMICS [CR2b] (4-5 wks)
- Forces, types, and representation (FBD)
- Newton’s First, Second, and Third Laws
- Applications of Newton’s Second Law
- Friction
- Interacting objects: ropes and pulleys

UNIT 3. CIRCULAR MOTION AND GRAVITATION [CR2c] (2wks)
- Uniform circular motion
- Dynamics of uniform circular motion
- Universal Law of Gravitation

UNIT 4. ENERGY [CR2f] (3-4 wks)
- Work & Power
- Mechanical Energy – Kinetic, Gravitational and Elastic
- Conservation of energy

UNIT 5. MOMENTUM [CR2e] (2wks)
- Impulse
- Momentum
- Conservation of momentum
- Elastic and inelastic collisions

UNIT 6. SIMPLE HARMONIC MOTION [CR2d] (2wks)
- Linear restoring forces and simple harmonic motion
- Simple harmonic motion graphs
- Simple pendulum
- Mass-spring systems

CR2a—The course design provides opportunities for students to develop understanding of the foundational principles of Kinematics.

CR2b—The course design provides opportunities for students to develop understanding of the foundational principles of dynamics.

CR2c—The course design provides opportunities for students to develop understanding of the foundational principles of gravitation and circular motion.

CR2f—The course design provides opportunities for students to develop understanding of the foundational principle of energy.

CR2e—The course design provides opportunities for students to develop understanding of the foundational principles of linear momentum.

CR2d—The course design provides opportunities for students to develop understanding of the foundational principles of simple harmonic motion.
UNIT 7. ROTATIONAL MOTION [CR2g] (2-3wks)
- Torque
- Center of mass
- Rotational kinematics
- Rotational dynamics and rotational inertia
- Rotational energy
- Angular momentum
- Conservation of angular momentum

UNIT 8. MECHANICAL WAVES [CR2h] (2wks)
- Traveling waves
- Wave characteristics
- Sound
- Superposition
- Standing waves on a string
- Standing sound waves

UNIT 9. ELECTROSTATICS [CR2i] (2wks)
- Electric charge and conservation of charge
- Electric force: Coulomb's Law

UNIT 10. DC CIRCUITS [CR2j] (3wks)
- Electric resistance
- Ohm's Law
- DC circuits
- Series and parallel connections
- Kirchhoff's Laws

LABORATORY INVESTIGATIONS

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. Students also investigate topic-related questions that are formulated through student designed/selected procedures.

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] **The laboratories listed are a representation of the kinds of labs that will be performed in class. This list is fluid and is subject to change.**
### UNIT 1. KINEMATICS

#### LAB INVESTIGATION OBJECTIVE(S)
(Investigation identifier: Guided-Inquiry: GI Open-Inquiry: OI)**

1. **Meeting Point**  
   To predict where two battery-powered cars will collide if they are released from opposite ends of the lab table at different times.

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.

3. **Free-Fall Investigation**  
   To determine and compare the acceleration of two objects dropped simultaneously.

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.

5. **Shoot the Target (GI)**  
   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.

6. **Speed and Acceleration Using Air Tracks (GI)**  
   Students will use air tracks with photogates to determine acceleration and speed.

### UNIT 2. DYNAMICS

7. **Analysis of Air Resistance (GI)**  
   To determine the forces of air resistance on a coffee filter.

8. **Forces Inventory (GI)**  
   Qualitative and quantitative investigation on a variety of interactions between objects.

9. **Static Equilibrium Challenge**  
   To determine the mass of a hanging object in a setup with three strings at various angles.

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.

11. **Coefficient of Friction (GI)**  
    To determine the maximum coefficient of static friction between a shoe and a wooden plank.

12. **Atwood’s Machine (GI)**  
    To determine the acceleration of a hanging mass and the tension in the string.

### UNIT 3. CIRCULAR MOTION

13. **Flying Toy (GI)**  
    To determine the tension in the string and the centripetal acceleration of the flying toy.

### UNIT 4. ENERGY [CR6a]

14. **Roller Coaster Investigation (GI)**  
    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.

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.

16. **Energy and Non-Conservative Forces (GI)**  
    To determine the energy dissipated by friction of a system consisting of a modified Atwood’s machine.
### UNIT 5. MOMENTUM

<table>
<thead>
<tr>
<th>17. Bumper Design (GI)</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>18. Impulse and Change in Momentum (GI)</td>
<td>To measure the change in momentum of a dynamics cart and compare it to the impulse received.</td>
</tr>
<tr>
<td>19. Elastic and Inelastic Collisions (OI)</td>
<td>To investigate conservation of momentum and conservation of energy using a ballistic pendulum to determine the type of collision.</td>
</tr>
<tr>
<td>20. Forensic Investigation (OI)</td>
<td>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.</td>
</tr>
</tbody>
</table>

### UNIT 6. SIMPLE HARMONIC MOTION

<table>
<thead>
<tr>
<th>21. Finding the Spring Constant (GI)</th>
<th>To design two independent experiments to determine the spring constants of various springs of equal length.</th>
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</thead>
<tbody>
<tr>
<td>22. Graphs of an Oscillating System (GI)</td>
<td>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.</td>
</tr>
<tr>
<td>23. Simple Pendulum Investigation (GI)</td>
<td>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.</td>
</tr>
</tbody>
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### UNIT 7. ROTATIONAL MOTION

<table>
<thead>
<tr>
<th>24. Torque and the Human Arm (OI)</th>
<th>To design and build an apparatus that replicates the forearm and bicep muscle system to determine the biceps tension when holding an object in a lifted position.</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. Rotational Inertia (GI)</td>
<td>To determine the rotational inertia of a cylinder from the slope of a graph of an applied torque versus angular acceleration.</td>
</tr>
<tr>
<td>26. Conservation of Angular Momentum (GI)</td>
<td>To investigate how the angular momentum of a rotating system responds to changes in the rotational inertia.</td>
</tr>
</tbody>
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### UNIT 8. MECHANICAL WAVES

<table>
<thead>
<tr>
<th>27. Mechanical Waves (GI)</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>28. Speed of Sound (GI)</td>
<td>Design two different procedures to determine the speed of sound in air.</td>
</tr>
<tr>
<td>29. Wave Boundary Behavior (GI)</td>
<td>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).</td>
</tr>
<tr>
<td>30. Standing Waves (GI)</td>
<td>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.</td>
</tr>
</tbody>
</table>
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.

32. Coulomb’s Law (GI)
To estimate the charge on two identical, equally charged spherical pith balls of known mass.

UNIT 10. DC CIRCUITS
33. Brightness Investigation (GI)
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.

35. Resistance and Resistivity (GI)
To investigate the effects of cross-sectional area and length on the flow of current through a representation of resistance and resistors.

36. Series and Parallel Circuits (GI)
To investigate the behavior of resistors in series, parallel, and series-parallel circuits. The lab should include measurements of voltage and current.

INSTRUCTIONAL ACTIVITIES
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. REAL WORLD APPLICATION
ACTIVITY: Torque and Art [CR4]
DESCRIPTION:
This activity provides an opportunity for students to see the complexity in an everyday object. Students design and build a mobile that will demonstrate both translational and rotational equilibrium. They can use readily available materials in the classroom, their home, or they can use any other supplies as they wish. In their lab report, students are required to document the different stages of their design. Required elements include project procedure, design sketches, scaled blueprint, force diagrams, mathematical representations of translational and rotational equilibrium, and numerical calculations.

Learning Objective 3.F.1.1
The student is able to use representations of the relationship between force and torque.

Learning Objective 3.F.1.2
The student is able to compare the torques on an object caused by various forces.

Learning Objective 3.F.1.3
The student is able to estimate the torque on an object caused by various forces in comparison to other situations.

Learning Objective 3.F.1.4
The student is able to design an experiment and analyze data testing a question about torques in a balanced rigid system.

Learning Objective 3.F.1.5
The student is able to calculate torques on a two-dimensional system in static equilibrium, by examining a representation or model.

CR3—Students have opportunities to apply AP Physics 1 learning objectives connecting across enduring understandings as described in the curriculum framework. These opportunities must occur in addition to those within laboratory investigations.

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.
2. SCIENTIFIC ARGUMENTATION
In the course, students become familiar with the three components of scientific argumentation. The first element is the claim, which is the response to a prediction. A claim provides an explanation for why or how something happens in a laboratory investigation. The second component is the evidence, which supports the claim and consists of the analysis of the data collected during the investigation. The third component consists of questioning, in which students examine and defend one another’s claims. Students receive explicit instruction in posing meaningful questions that include questions of clarification, questions that probe assumptions, and questions that probe implications and consequences. As a result of the scientific argumentation process, students are able to revise their claims and make revisions as appropriate [CR8].

ACTIVITY 1: Formative Assessment: Changing Representations in Energy Description:
Students work in pairs to create exercises that involve translation from one representation to another. Some possible translations are:
- from a bar chart to a mathematical representation
- from a physical situation diagram to a bar chart
- from an equation to a bar chart
Each pair of students exchanges their exercises with another pair. After the students work through the exercises they received, the pairs meet and offer constructive criticism (peer critique) on each other’s solutions.

Learning Objective 5.B.4.1
The student is able to describe and make predictions about the internal energy of everyday systems.

Learning Objective 5.B.4.2
The student is able to calculate changes in kinetic energy and potential energy of a system, using information from representations of that system.

ACTIVITY 2: Real World Physics Solutions Description:
In order for students to become scientifically literate citizens, students are required to use their knowledge of physics while looking at a real world problem. [CR4]
Students may pick one of the following solutions:
- Students will pick a Hollywood movie and will point out three (or more) instances of bad physics. They will present this information to the class, describing the inaccuracies both qualitatively and quantitatively.
- Students will research a thrill ride at an amusement park. They will present information to the class on the safety features of the ride, and why they are in place.
- Students will present information to the class on noise pollution, and it’s danger to both human and animal life. They will also propose solutions to noise pollution problems.
- Students will go to the insurance institute of highway safety website (iihs.org) and will look at the safest cars in a crash. They will present information as to why these cars are safer and how the safety features keep people safe.

CR8—The course provides opportunities for students to develop written and oral scientific argumentation skills.

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.