FBISD

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AP Physics 1 Master Syllabus

Purpose: It is the intention of this Administrative-Master Syllabus to provide a general description of the course, outline the required elements of the course and to lay the foundation for course assessment for the improvement of student learning, as specified by FBISD, regardless of who teaches the course, the timeframe by which it is instructed, or the instructional method by which the course is delivered. It is not intended to restrict the manner by which an individual faculty member teaches the course but to be an administrative tool to aid in the improvement of instruction.

Course Title	Department	Credits	Course Code	Prerequisites
AP Physics 1	Science	1.0	SC421	Geometry or concurrent enrollment in Algebra II

I. PROGRAM INFORMATION

Program Guide Course Description: The AP Physics 1 course covers Newtonian mechanics (including rotational dynamics and angular momentum); work, energy, and power; mechanical waves and sound. It will also introduce electric circuits and modern physics. Knowledge of algebra is required. Understanding of the basic principles involved and the ability to apply these principles in the solution of problems through inquiry is the goal of this course. At many colleges this is a semester course including laboratory component, which often provides a foundation in physics for student in life sciences, pre-medicine, and some applied sciences, as well as other fields not related to science. Laboratory investigations utilize computer applications when possible. This course does not require evening lab time. The focus of this course is preparation for successful completion of the AP Physics I exam in May.

Primary Textbook: Knight, Randall Dewey, Brian Jones, and Stuart Field. 2015. College Physics: A Strategic Approach. 3rd Ed. Pearson: Boston MA.
ISBN: 9780133539677 Adoption Period: 2014-2022

Optional Text(s) and/or Materials: N/A

Websites: APcentral.collegeboard.com; https://phet.colorado.edu/en/simulations/category/new; www.edx.org

Course Overview: The course focuses on the interconnections between the various strands and units contained in the course syllabus and how each contributes to the "Big Ideas" that provide a core foundation for this science course. Problem-solving techniques and strategies are fine-tuned throughout the year, and students are continually tasked with connecting physics applications learned in different units in order to synthesize solutions to complex problems.

Grading System: The State Board of Education has set 70 as a minimum passing grade. Written communication of the student's achievement is reported to the parents on a nine weeks basis. When letter grades are recorded, the following conversions are used: 90-100 = A, 80-89 = B, 75-79 = C, 70-74 = D, 69-below = F

Actual student numerical grades are recorded in the grade book and averaged as actual grades. An incomplete (I) is given on a report card if a student, because of illness or for some other excused reason, cannot complete the required work by the end of the reporting period. The work must be made up. The student should contact the teacher to arrange to complete the work.

Attendance: Students must be in attendance a minimum of 90 percent of the days after enrollment in the course.

In the event that grading or attendance guidelines conflict with FBISD district policy, the district policy will be followed.

II. LAB INVESTIGATIONS

Lab Requirements: Investigative labs will account a minimum of 25% of the course instruction. Labs emphasize development and testing of the hypothesis, collection, analysis and presentation of data, as well as discussion of results to discover unanswered questions about the particular topics addressed. Students will participate in a minimum of forty (40) hours of applied laboratory activities, aligned to big ideas throughout the full course as they occur within the curriculum. Students are required to report on all laboratory investigations. Laboratory design, experimentation, data gathering, data presentation, analysis, drawing conclusions, and experimental error analysis are elements in these lab activities. The student-directed and inquiry-based laboratory investigations used throughout the course enable students to apply the seven science practices as defined in the Curriculum Framework.

Big Idea	Lab Investigation/Description	Science Practice 1	Science Practice 2	Science Practice 3	Science Practice 4	Science Practice 5	Science Practice 6	Science Practice 7
1	Measurement **(N)** To determine the relationship between the circumference and the diameter of circular or spherical objects.	✓		✓		✓		✓
3	Motion Graphs – Constant Velocity **(I)** 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	Motion Graphs – Constant Acceleration **(I)** 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, 4	Projectile Motion **(G)** To determine and compare the acceleration of two objects dropped simultaneously.	✓	✓		✓	✓		
1, 2, 3, 4	Newton's Equilibrium **(N)** 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.	✓	✓	✓	✓	✓	✓	
3, 5	Hooke's Law **(G)** To use Hooke's Law to determine the spring constant of a spring.	✓	✓	✓	✓	✓	✓	
3, 4	Friction **(G)**	✓	✓	✓	✓	✓	✓	✓

	To determine the maximum coefficient of static friction between a shoe and a wooden plank.							
3, 4, 5	Conservation of Energy **(I)** 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.	✓	✓	✓	✓	✓	✓	✓
3, 4, 5	Conservation of Momentum **(I)** To determine the momentum for both carts before and after the collision and compare the total momentum of the two carts before collision to the total momentum of both carts after collision.	✓	✓	✓	✓	✓	✓	✓
3, 4 ,5	Impulse **(G)** To determine the similarities between the change in momentum and the impulse (net force multiplied by time) in a collision.	✓	✓		✓	✓	✓	✓
3, 4, 5	Torque **(I)** 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.	✓	✓		✓	✓	✓	✓
3, 4, 5	Rotational Inertia **(G)** To determine the rotational inertia of a cylinder from the slope of a graph of an applied torque versus angular acceleration.	✓	✓	✓	✓	✓	✓	✓
3, 4, 5, 6	Harmonic Motion (Pendulum & Spring) **(I)** 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.	✓	✓	✓	✓	✓	✓	✓
6	Resonance **(N)** Design two different procedures to determine the speed of sound in air	✓	✓			✓	✓	
1, 3, 5	Electrostatics **(G)** To estimate the charge on two identical, equally charged spherical pith balls of known mass using Coulomb's Law	✓		✓			✓	✓
1, 5	Series & Parallel DC Circuits **(N)** To investigate the behavior of resistors in series, parallel, and series-parallel circuits. The lab should include measurements of voltage and current.	✓	✓	✓		✓	✓	

1, 5	Complex DC Circuits **(G)** To explore Kirchhoff's two laws of electrical circuits using a voltage sensor and current sensor to measure the voltage and current across and through parts of a complex circuit.	✓	✓	✓	✓	✓		
1- 6	*At Home Projects **(I)** See Instructional Strategies Section	✓	✓	✓	✓	✓	✓	✓

Possible at-home projects might include (but are not limited to) building roller coasters, Rube Goldberg machines, catapults, model homes, speakers, and home videos

I: Open inquiry-based investigation G: Guided inquiry-based investigation N: Not inquiry-based investigation

III. BIG IDEAS

Course content is structured around enduring understandings within six big ideas which organize thought about physics.

- Big idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big idea 2: Fields existing in space can be used to explain interactions.
- Big idea 3: The interactions of an object with other objects can be described by forces.
- Big idea 4: Interactions between systems can result in changes in those systems.
- Big idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big idea 6: 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.

IV. PHYSICS PRACTICES

Scientific practices are embedded throughout the curriculum to promote a more engaging and rigorous experience. These practices require that students:

1. Use representations and models to communicate scientific phenomena and solve scientific problems;
2. Use mathematics appropriately;
3. Engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course;
4. Plan and implement data collection strategies appropriate to a particular scientific question;
5. Perform data analysis and evaluation of evidence;
6. Work with scientific explanations and theories; and
7. Connect and relate knowledge across various scales, concepts and representations in and across domains.

V. COURSE LEARNING OUTCOMES/CURRICULUM REQUIREMENTS

Grading Period	Learning Objectives	Topics & Activities	1. Use representations and models	2. Use mathematics	3. Engage in scientific strategies	4. Plan & implement data collection strategies	5. Perform data analysis & evaluation of evidence	6. Work with scientific explanations/theories	7. Connect & relate knowledge	Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.	Big Idea 2: Fields existing in space can be used to explain interactions.	Big Idea 3: The interactions of an object with other objects can be described by forces.	Big Idea 4: Interactions between systems can result in changes in those systems.	Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.	Big Idea 6: 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.	Chapter, Pages	Est. Time Frame
1st	**Unit 1: Measurements and Data**																
		Topics:															5 days
		• Safety			✓				✓	✓						N/A	
		• Scientific Method	✓		✓	✓	✓									Ch. 1 11-15	
		• Graphical Analysis	✓		✓	✓	✓	✓	✓							Ch. 2 29-51	
		• Recording Data	✓			✓		✓								Ch. 2 29-51	
		• Algebra		✓												Appendix A1-A2	
		Activities:															
		• Measurement Lab	✓	✓			✓		✓							N/A	
		• Safety Demo	✓		✓											N/A	
		• Graphical Analysis	✓		✓	✓	✓	✓	✓							Ch. 2 29-51	
	Unit 2: Kinematics																
	3.A.1.1, 3.A.1.2, 3.A.1.3, 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,	Topics:															32 days
		• 1D Motion	✓	✓	✓	✓	✓	✓	✓	✓						Ch. 1 3-10	
		• 2D Motion	✓	✓	✓	✓	✓	✓	✓	✓						Ch. 1 16-21	
		• Acceleration	✓	✓	✓	✓	✓	✓	✓	✓	✓					Ch. 2 38-54	
		• Vectors	✓	✓	✓	✓	✓	✓	✓	✓						Ch. 3 65-80	
		Activities:															

	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	• Motion Graphs – Constant Velocity	✓	✓	✓	✓	✓	✓	✓	✓						Ch. 2 29-38	
		• Motion Graphs – Constant Acc.	✓	✓	✓	✓	✓	✓	✓	✓	✓					Ch. 2 38-54	
		• Projectile Motion	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		Ch. 3 80-85	
2nd	**Unit 3: Dynamics**																
	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	**Topics:**															25 days
		• Newton's Laws	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				Ch. 4 97-114	
		• Free Body Diagrams	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				Ch. 4 112-114	
		• Friction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			Ch. 5 137-142	
		• Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			Ch. 5 145-147	
		• Circular Motion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			Ch. 6 161-180	
		• Gravitation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			Ch.6 175-181	
		Activities:															
		• Newton's Equilibrium	✓	✓	✓	✓	✓	✓	✓	✓		✓				Ch. 4 97-114	
		• Hooke's Law	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			Ch. 4 102-107	
		• Friction	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			Ch. 5 137-142	
		• Circular Motion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			Ch. 6 161-180	
	Unit 4: Work, Power and Energy																
	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,	**Topics:**															15 days
		• Work	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		Ch. 10 288-291	
		• Mechanical Energy	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		Ch. 10 292-300	
		• Conservation of Energy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		Ch. 10 300-307	
		• Power	✓	✓	✓	✓	✓	✓	✓	✓		✓				Ch. 10 307-310	
		Activities:															
		• Conservation of Energy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		Ch. 10 300-307	

	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	• Hooke's Law	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		Ch. 4 102-107	
		• Power Demo	✓	✓	✓	✓	✓	✓	✓	✓		✓				Ch. 10 307-310	
	Unit 5: Momentum																
	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	**Topics:**															15 days
		• Momentum	✓	✓	✓	✓	✓	✓	✓	✓						Ch. 9 254-276	
		• Impulse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				Ch. 9 255-260	
		• 1D Conservation of Momentum	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		Ch. 9 262-269	
		• 2D Conservation of Momentum	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		Ch. 9 269-270	
		Activities:															
		• Conservation of Momentum	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		Ch. 9 262-270	
		• Impulse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				Ch. 9 255-260	
3rd	**Unit 6: Rotational Dynamics**																
	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	**Topics:**															20 days
		• Angular Conversions	✓	✓	✓	✓	✓	✓	✓							Ch. 7 190-197	
		• Torque	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			Ch. 7 198-203	
		• Center of Gravity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			Ch. 7 203-206	
		• Moment of Inertia	✓	✓	✓	✓	✓	✓	✓	✓		✓				Ch. 7 206-210	
		• Equilibrium	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			Ch. 8 226-232	
		• Angular Momentum	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		Ch. 7 206-217	
		• Rotational Energy	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		Ch. 10 294-294	
		Activities:															
		• Torque Lab	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			Ch. 7 198-203	
		• Moment of Inertia Lab	✓	✓	✓	✓	✓	✓	✓	✓		✓				Ch. 7 206-210	
		• Conservation of Ang. Mom. Demo	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		Ch. 9 270-275	

	Unit 7: Oscillations																
	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	**Topics:**															12 days
		• Restoring Forces	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	Ch. 14 441-442	
		• Simple Harmonic Motion	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	Ch. 14 443-454	
		Activities:															
		• Spring Lab	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	Ch. 14 441-448	
		• Pendulum Lab	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Ch. 14 453-455	
4^{th}	**Unit 8: Mechanical Waves**																
	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	**Topics:**															12 days
		• Wave Model	✓	✓	✓	✓	✓	✓	✓	✓					✓	Ch. 15 471-472	
		• Wave Types (including sound waves)	✓		✓	✓	✓	✓	✓	✓					✓	Ch. 15 471-482	
		• Interference & standing waves	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	Ch. 16 501-523	
		Activities:															
		• Resonance Lab	✓	✓	✓	✓	✓	✓	✓	✓					✓	Ch. 16 502-513	
		• Standing Waves Lab	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	Ch. 16 502-513	
	Unit 8: Electrostatics and Circuits																
	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	**Topics:**															15 days
		• Conservation of Electric Charge	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		Ch. 20 633-640	
		• Electric Forces (Coulomb's Law)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			Ch. 20 641-657	
		• Electric Fields and Potential	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		Ch. 21 666-674	
		• Current and Resistance	✓	✓	✓	✓	✓	✓	✓	✓						Ch. 22 703-707	
		• Simple DC Circuits (using Ohm's Law and Kirchhoff's rules)	✓	✓	✓	✓	✓	✓	✓	✓				✓		Ch. 23 728-736	
		• Complex DC Circuits (Using Ohm's Laws and Kirchhoff's rules)	✓	✓	✓	✓	✓	✓	✓	✓				✓		Ch. 23 737-740	

		Activities:															
		• Triboelectric Effect Demo	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		Ch. 20 632-656	
		• Resistivity Activity	✓	✓	✓	✓	✓	✓	✓	✓		✓				Ch. 22 702-707	
		• Simple Series DC Circuit Lab	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		Ch. 23 727-739	
		• Simple Parallel DC Circuits	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		Ch. 23 732-737	
		• Complex DC Circuits	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		Ch. 23 737-740	
	AP Review																
	All Learning Objectives covered during the year	Review Big Ideas, Practice Free Response, Practice Multiple Choice, Review Labs, Preparation of review note cards															5 days
	Summative Independent Project																
	All LOs Possible	**Possible Topics:**															19 days
		• Rube Goldberg contest															
		• Physics of Toys															
		• Photo Contest (from AAPT)															

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. **PROJECT DESIGN:** Students engage in hands-on activities outside of the laboratory experience to meet learning objectives across Enduring Understandings.

   Students design a car that accelerates the fastest using kinetic box with rubber bands. The students use a photogate sensor that allows them to make acceleration measurements, collect data, and infer conclusions from graphs of d vs. t, v vs. t, and a vs.t. The students then calculate the kinetic energy as well as the work done using the work/energy theorem as the car runs forward on various surfaces such as glass, tile, and concrete.

   Learning Objectives: 3.A.1.3, 3.E.1.1, 3.E.1.4, 5.B.4.2, 5.B.5.5

2. **REAL WORLD APPLICATION:** The following activity provides an opportunity for students to make an interdisciplinary connection.

   Water Balloon Launcher – Students are tasked to build a water balloon launcher to meet predetermined specifications (accuracy and/or distance). The launcher must be portable (carried by 1 student). Students are free to use their creativity to implement the specifications, but are not allowed to use slingshot-type launch systems. Students must calculate an estimate of the potential energy that is converted to kinetic energy and the average force over time needed to change the momentum of the balloon. Students will have to record test footage and take measurements in order to use kinematics to make estimates of velocities and launch acceleration.

3. **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.

   In the Hooke's law paradigm lab (Unit 3), students first observe a demonstration of the Hooke's law apparatus. Then they engage in a whole-class discussion about apparatus. They propose governing variables, and make claims about the effect of those variables. Groups are assigned to investigate those claims in an experiment, and the whole class evaluates the claims made in light of the data from the lab. Other paradigm labs follow this pattern.