AP® Physics 1 Syllabus

This document is intended to fulfill both the requirements of the Lynn Public Schools and the College Board. The parts of this syllabus that are intended to satisfy the requirements of the College Board start on page 3.

Course Information

Course Name: AP® Physics 1: Algebra-Based (or AP® Physics 1)

College Board Syllabus Number: 1571340v1

Syllabus URL: http://www.mrbigler.com/AP-Physics-1/syllabus-AP-Physics-1.PDF

LPS Course Number: 178

Credits: 6 credits

School: Lynn English High School, Lynn, MA

School Code: 221265

Room: 304

Teacher: Mr. Jeffrey Bigler

Email: MrBigler@MrBigler.com or BiglerJ@LynnSchools.org

Afternoon Back: officially Wednesday, but I'm also available most Mondays, Thursdays, & Fridays

Science Prerequisite: passed MCAS Biology with 240 or better **and** either B− or better in honors Chemistry 1 or B+ or better in CP1 Chemistry 1.

Math Prerequisite: B− or better in Honors Algebra 2

Textbook: *Physics Fundamentals,* by Vincent P. Coletta. (Physics Curriculum & Instruction, Inc.: 2010). Available to students in both print (hardcover) and electronic form.

Supplemental Text: *AP® Physics 1 Class Notes,* by Mr. Bigler. (Self-published through CreateSpace.com.) Available to students in both print (softcover) and electronic form.

Required Materials: textbook & supplemental text, a folder or binder (to keep worksheets and handouts), lab notebook (composition book; pages must *not* be removable), scientific (or graphing) calculator (must have exponents, trigonometry functions and scientific notation).

Classroom Expectations

Detailed policies & procedures are described in a separate document.

In summary:

1. Maintain a positive attitude, with ongoing effort and willingness to be proactive about getting extra help when needed.
2. Complete all assignments in the time allotted, unless prior arrangements have been made. Students are encouraged to collaborate on homework, but it is your responsibility to make sure that you are ultimately capable of solving each of the problems on your own and without assistance.
3. Be present during class, both mentally and physically. Arrive on time. Maintain focus and effort. Contribute to discussions. Bring completed assignments, notes, calculator & writing implements to class.

4. If you are struggling, come in for extra help after school. Mr. Bigler's official afternoon back is Monday. However, he is usually available after school every afternoon except for Tuesdays (which is when the Science Team meets), unless his presence is required at an after-school meeting. (Please confirm his availability during the school day to make sure. Faculty meetings are on the first Wednesday of every month; science department meetings are on the second Thursday of every month.)
5. Do your own work on tests and quizzes. Cheating, copying or plagiarism will result in a zero and notification of parent or guardian. More importantly, cheating will not help you learn anything or pass the AP exam.
6. Treat all staff, students, equipment and furniture appropriately and respectfully.
7. Mr. Bigler does not use a lab safety contract—safety is required at all times and is not something you have the option of agreeing to or not. Mr. Bigler will not micromanage your lab experiences, but he will make sure you know what the potential dangers are and how to keep yourself and everyone else safe. Safety violations may result in a disciplinary referral, loss of the privilege of participating in the lab or activity (which may result in a failing grade) and/or payment of restitution for damaged equipment.
8. Adhere to all school rules, policies and procedures as published in the student handbook.

Grades

Your grade is calculated by the *eSchool Plus* grading system, based on the grade weights entered by Mr. Bigler. The grade weights are:

- Unit tests, formal lab reports, and major projects: 100 points
- Quizzes, lab write-ups, and minor projects: 50 points
- Participation in lab experiments: 25 points
- Homework & classwork assignments: 5 points
- Mid-term exam: 150 points

Mr. Bigler is responsible for entering grades and weights into *eSchool Plus*, but the grades themselves are calculated by *eSchool Plus*. You are responsible for monitoring your grades through the Home Access Center (HAC).

If you believe that your grade has been calculated incorrectly, it is your responsibility to bring it to Mr. Bigler's attention. He will check the calculation manually and adjust your grade as appropriate.

Homework

Homework is due at the beginning of class and will be graded ✓+ (5 points) or ✓− (4 points), based on how much of the homework you attempted (with work shown). Retrieving your homework from your locker after class has started costs 1 point. Late work is worth 3 points if turned in before the unit test on the topic, and 2 points afterwards, provided that it is 100% complete and has correct answers and all work shown. Students who are in the building at any time during the school day (even if they are on a field trip during physics class) are expected to turn in assignments on the due date.

Attendance & Make-Up Work

Absent students are expected to obtain and complete any assignments that they missed. Absent students are also expected to schedule make-up tests with Mr. Bigler within one week, unless other arrangements are made on the day the student returns to school. According to LEHS policy, students who are absent from school seven or more times during a quarter (as calculated by TAC) receive a failing grade for the quarter in all classes.

Curricular Requirements		Page(s)
CR1	Students and teachers have access to college-level resources including college-level textbooks and reference materials in print or electronic format.	4
CR2a	The course design provides opportunities for students to develop understanding of the foundational principles of kinematics in the context of the big ideas that organize the curriculum framework.	6
CR2b	The course design provides opportunities for students to develop understanding of the foundational principles of dynamics in the context of the big ideas that organize the curriculum framework.	6
CR2c	The course design provides opportunities for students to develop understanding of the foundational principles of gravitation and circular motion in the context of the big ideas that organize the curriculum framework.	6
CR2d	The course design provides opportunities for students to develop understanding of the foundational principles of simple harmonic motion in the context of the big ideas that organize the curriculum framework.	6
CR2e	The course design provides opportunities for students to develop understanding of the foundational principles of linear momentum in the context of the big ideas that organize the curriculum framework.	6
CR2f	The course design provides opportunities for students to develop understanding of the foundational principle of energy in the context of the big ideas that organize the curriculum framework.	6
CR2g	The course design provides opportunities for students to develop understanding of the foundational principles of rotational motion in the context of the big ideas that organize the curriculum framework.	6
CR2h	The course design provides opportunities for students to develop understanding of the foundational principles of electrostatics in the context of the big ideas that organize the curriculum framework.	6
CR2i	The course design provides opportunities for students to develop understanding of the foundational principles of electric circuits in the context of the big ideas that organize the curriculum framework.	6
CR2j	The course design provides opportunities for students to develop understanding of the foundational principles of mechanical waves in the context of the big ideas that organize the curriculum framework.	6
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.	7
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.	7

Curricular Requirements		Page(s)
CR5	Students are provided with the opportunity to spend a minimum of 25 percent of instructional time engaging in hands-on laboratory work with an emphasis on inquiry-based investigations.	8
CR6a	The laboratory work used throughout the course includes investigations that support the foundational AP Physics 1 principles.	8–7
CR6b	The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.	5–7
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.	8
CR8	The course provides opportunities for students to develop written and oral scientific argumentation skills.	7

Course Introduction

Textbook:

Coletta, Vincent P. *Physics Fundamentals.* 2nd Edition. Lakeville, MN: Physics Curriculum & Instruction, Inc., 2010. Available to students in both print and electronic formats. **[CR1]**

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

Supplemental Text: Mr. Bigler. *Class Notes for AP® Physics 1*. Self-published through CreateSpace.com. Available to students in both print and electronic formats.

About this course:

The AP Physics 1 course meets for five periods of 48 minutes each plus one contiguous 90-minute period for lab work in each seven-day cycle. **[CR5]** Lab work is integral to the understanding of the concepts in AP® Physics 1, which has been designed by the College Board as a course equivalent to the algebra-based college-level physics class. At the end of the course, students will take the AP® Physics 1 Exam, which will test their knowledge and ability to apply the concepts taught in the classroom and learned through experimentation.

CR5: Students are provided with the opportunity to spend a minimum of 25 percent of instructional time engaging in hands-on laboratory work with an emphasis on inquiry-based investigations.

The content for the course is based on six big ideas:

- 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.

Evaluation:

Students will be graded on homework, quizzes, laboratory work, projects, and exams. Exams and will consist of questions similar to the ones students will see on the AP Exam. Homework assignments and quizzes will consist of problems from the textbook, supplements, and old AP Exams. Projects are long-term, and typically will involve groups of students developing a plan, collecting data and/or research, and presenting conclusions in a meaningful way. Laboratory work is student-centered and inquiry-based, as discussed below.

Grades will be determined based on students' completion of homework, performance on tests and quizzes, and quality of content and writing for laboratory reports.

Topics Covered:

1. Kinematics (Big Idea 3)
    a. Vectors/Scalars **[CR2a]**
    b. One-Dimensional Motion (including graphing position, velocity, and acceleration) **[CR2a]**
    c. Two-Dimensional Motion **[CR2a]**
    d. Rotational Kinematics **[CR2g]**
2. Dynamics (Big Ideas 1, 2, 3, and 4)
    a. Newton's Laws of Motion and Forces **[CR2b]**
    b. Torque and Rotational Dynamics **[CR2g]**
3. Universal Law of Gravitation (Big Ideas 1, 2, 3, and 4)
    a. Circular Motion **[CR2c]**
4. Simple Harmonic Motion (Big Ideas 3 and 5)
    a. Simple Pendulums **[CR2d]**
    b. Mass-Spring Oscillators **[CR2d]**
5. Momentum (Big Ideas 3, 4, and 5)
    a. Impulse and Momentum **[CR2e]**
    b. The Law of Conservation of Momentum **[CR2e]**
    c. Angular Momentum **[CR2g]**
    d. Conservation of Angular Momentum **[CR2g]**
6. Energy (Big Ideas 3, 4, and 5)
    a. Work **[CR2f]**
    b. Energy **[CR2f]**
    c. Conservation of Energy **[CR2f]**
    d. Power **[CR2f]**
    e. Rotational Energy **[CR2g]**
7. Electrostatics (Big Ideas 1, 3, and 5)
    a. Electric Charge **[CR2h]**
    b. The Law of Conservation of Electric Charge **[CR2h]**
    c. Electrostatic Forces **[CR2h]**
8. Circuits (Big Ideas 1 and 5)
    a. Ohm's Law **[CR2i]**
    b. Kirchhoff's Laws **[CR2i]**
    c. Simple DC Circuits **[CR2i]**
9. Mechanical Waves and Sound (Big Idea 6) **[CR2j]**

CR2a: The course design provides opportunities for students to develop understanding of the foundational principles of kinematics in the context of the big ideas that organize the curriculum framework.

CR2b: The course design provides opportunities for students to develop understanding of the foundational principles of dynamics in the context of the big ideas that organize the curriculum framework.

CR2c: The course design provides opportunities for students to develop understanding of the foundational principles of gravitation and circular motion in the context of the big ideas that organize the curriculum framework.

CR2d: The course design provides opportunities for students to develop understanding of the foundational principles of simple harmonic motion in the context of the big ideas that organize the curriculum framework.

CR2e: The course design provides opportunities for students to develop understanding of the foundational principles of linear momentum in the context of the big ideas that organize the curriculum framework.

CR2f: The course design provides opportunities for students to develop understanding of the foundational principle of energy in the context of the big ideas that organize the curriculum framework.

CR2g: The course design provides opportunities for students to develop understanding of the foundational principles of rotational motion in the context of the big ideas that organize the curriculum framework.

CR2h: The course design provides opportunities for students to develop understanding of the foundational principles of electrostatics in the context of the big ideas that organize the curriculum framework.

CR2i: The course design provides opportunities for students to develop understanding of the foundational principles of electric circuits in the context of the big ideas that organize the curriculum framework.

CR2j: The course design provides opportunities for students to develop understanding of the foundational principles of electric circuits in the context of the big ideas that organize the curriculum framework.

Outside the Classroom Lab Experience

In addition to in-class lab experiments, students will be required to construct a "Rube Goldberg" device that can time a ten-second interval. **[CR3]** The device must perform three or more separate and distinct actions, and each of the following must occur at least once during the operation of the device:

- conversion of stored potential energy to kinetic energy **[LO 5.B.3.1, 5.B.3.3]**
- a transfer of momentum **[LO 3.D.1.1, 3.D.2.4]**
- application of a torque in order to cause or prevent a rotation **[LO 3.F.1.2, 3.F.2.1, 4.D.1.1]**

Each student will present his/her "Rube Goldberg" device to the class, briefly explaining how the device works and the physics involved in each of the three required processes listed above. The explanation must include both a qualitative (conceptual) explanation and quantitative estimates of these quantities (potential and/or kinetic energy, momentum transfer, and torque).

During the last 20 minutes of each day's presentations, the class will be polled for suggestions to improve the ability to function, reliability, or consistency one of the poorest-performing devices. When one of the devices has two or more distinct improvements suggested, each student in the class will choose one of the improvements to support, thus forming "teams." The teams will engage in a debate, with each side having 3 minutes to present the benefits of their proposed modification and 2 minutes to point out potential problems with the other teams' suggestions. Each team will be allowed a 2-minute rebuttal of the other team's arguments. **[CR8]** The student who built the device will moderate the debate, and at the end will choose one of the proposed modifications to accept, explaining which of the arguments was most convincing and why.

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.

Real World Physics Solutions

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] [Science Practices 3.1, 3.2, 3.3]** 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 choose a sport that they participate in and present an analysis of the physics involved and how specific physics principles can be applied in order to improve performance.

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.

Laboratory Activities:

A minimum of twenty-five percent of the course will be lab work. **[CR5]** Labs may take several class days to finish, and students may have to do work outside of class as well.

Students are expected to write up laboratory experiments in an appropriate laboratory notebook format. Lab reports will consist of the following components: **[CR7]**

- Title
- Objective
- Background/Experimental Design
- Data & Observations
- Analysis, including calculations, graphs, and qualitative and quantitative error analysis.
- Conclusions

Every major unit will involve one or more laboratory experiments **[CR6a]**, with an emphasis on guided inquiry **[CR6b]**. Collectively, laboratory work will engage students in all seven science practices.

Laboratory activities and simulations in this class are included the following table. The type of inquiry[1] (Structured Inquiry = SI; Guided Inquiry = GI) is noted in the second column.

CR5: Students are provided with the opportunity to spend a minimum of 25 percent of instructional time engaging in hands-on laboratory work with an emphasis on inquiry-based investigations.

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 investigations that support the foundational AP Physics 1 principles.

CR6b: The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.

[1] Martin-Hansen, Lisa. "Defining Inquiry." NSTA WebNews Digest, published 2/1/2002. Accessed via http://www.nsta.org/publications/news/story.aspx?id=46515 on 1/6/2015.

Name	Inquiry Format	Short Description	Science Practices
Thickness of Aluminum Foil	GI	Students devise and implement a procedure for measuring the thickness of a piece of aluminum foil	4.1, 4.2, 4.3, 5.2
Distance vs. Displacement	SI	Students attempt to maximize the difference between their distance traveled and displacement as they meander down a hallway.	1.4, 2.1, 2.2, 2.3, 4.2, 4.3, 4.4, 5.1
Speed vs. Velocity	SI	Students attempt to maximize the difference between their speed and velocity as they run back and forth down a hallway.	1.4, 2.1, 2.2, 2.3, 4.2, 4.3, 4.4, 5.1
Projectile Target Practice	GI	Students roll a marble down a ramp and off the end of a lab bench, and determine where to place a cup at a specific height above the floor in order to catch the marble.	1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2
Egg Drop	GI	Students drop a raw egg from the roof of the school and attempt to hit their physics teacher as he walks below at a constant velocity.	2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3, 7.1
Human Free-Body Diagram	SI	Students hang from a swing suspended by a rope from the top of a door. Students calculate their weight from the tension in the rope (using a spring scale) and the normal force from the door (using a bathroom scale).	1.1, 1.2, 1.4, 6.2, 6.4
Force Boards	SI	Students measure two forces at different angles on a force board, then calculate and confirm by measurement the magnitude of the third force needed to offset the other two.	4.3, 5.1, 5.2
Coefficient of Friction of a Scooter	GI	Students determine the overall coefficient of friction of the moving parts in a scooter as it coasts to a stop.	1.2, 1.4 1.5, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 4.4, 5.1, 6.2, 7.2
Balanced Torques	GI	Students weigh a board with two randomly placed eye hooks and calculate and then measure the force on two spring scales holding the board by the eye hooks.	2.1, 2.2, 2.3, 4.3, 5.1, 5.2, 5.3
Determination of Spring Constant	GI	Students determine the spring constant of a spring, both by measuring a force its displacement, and by measuring its frequency of oscillation.	2.1, 2.2, 2.3, 4.1, 4.2, 5.3, 4.4, 5.1, 5.2, 5.3
Riding a Momentum Cart	SI	Students ride down the hallway on a 24 kg cart measuring 2 m × 1 m and observe the immediate changes in velocity as another student jumps onto or off of the cart.	1.1, 1.2, 1.4, 6.2, 6.4
Air Track Collisions	SI	Students measure changes in momentum before and after collision of carts on an air track.	2.2, 2.3, 4.3, 5.1, 5.2, 5.3, 6.4

Name	Inquiry Format	Short Description	Science Practices
Ballistic Pendulum	SI	Students calculate the velocity of a steel ball fired into a ballistic pendulum.	1.2, 1.4, 1.5, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 4.42 5.1, 5.2, 6.2, 6.4, 7.1, 7.2
Projectile Target Practice, Revisited	GI	Students use the gravitational potential energy and translational and rotational kinetic energy at the bottom of the ramp to determine the velocity of a golf ball, then use projectile motion equations to calculate where the ball will land.	1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 7.2
Electronic Quiz Board	SI	Students build a circuit board to take a quiz, then measure voltage, current and resistance at different points in the circuit.	1.1, 1.2, 1.3, 1.4, 4.2, 5.2, 6.2
Speed of Sound in Air #1	SI	Students measure the speed of sound in air by performing an action that produces a sound from a distance of at least 100 m away.	2.2, 2.3, 4.2, 4.3, 5.1, 5.3
Speed of Sound in Air using a Resonance Tube	SI	Students measure the dimensions of a tube filled with water and determine the frequency of its resonance. This frequency is used to calculate the speed of sound in air.	2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3