SYLLABUS DEVELOPMENT GUIDE

AP® Physics 1

The guide contains the following information:

Curricular Requirements

The curricular requirements are the core elements of the course. A syllabus must provide explicit evidence of each requirement based on the required evidence statement(s). The Unit Guides and the "Instructional Approaches" section of the *AP® Physics 1: Algebra-Based Course and Exam Description* (CED) may be useful in providing evidence for satisfying these curricular requirements.

Required Evidence

These statements describe the type of evidence and level of detail required in the syllabus to demonstrate how the curricular requirement is met in the course.

Note**:** Curricular requirements may have more than one required evidence statement. Each statement must be addressed to fulfill the requirement.

Samples of Evidence

For each curricular requirement, two to three separate samples of evidence are provided. These samples provide either verbatim evidence or clear descriptions of what acceptable evidence could look like in a syllabus. In some samples, the specific language that addresses the required evidence is highlighted in **bold** text.

Curricular Requirements

CR1	Students and teachers have access to college-level resources, including a college-level textbook and reference materials in print or electronic format.	*See page:* 3
CR2	The course provides opportunities to develop student understanding of the required content outlined in each of the units described in the AP Physics 1 Course and Exam Description.	*See page:* 4
CR3	The course provides opportunities for students to develop the skills related to Science Practice 1: Creating Representations.	*See page:* 6
CR4	The course provides opportunities for students to develop the skills related to Science Practice 2: Mathematical Routines.	*See page:* 7
CR5	The course provides opportunities for students to develop the skills related to Science Practice 3: Scientific Questioning & Argumentation.	*See page:* 8
CR6	Students spend a minimum of 25% of instructional time engaged in hands-on laboratory investigations.	*See page:* 9
CR7	Students engage in hands-on laboratory investigations representative of the topics outlined in the AP Physics 1 Course and Exam Description.	*See page:* 10
CR8	The course provides opportunities for students to record evidence of their scientific investigations in a portfolio of lab reports or a lab notebook (print or digital format).	*See page:* 12

Curricular Requirement 1

Students and teachers have access to college-level resources, including a college-level textbook and reference materials in print or electronic format.

Required Evidence

- ☐ The teacher must provide the title, author, and publication date of an algebra-based, college-level textbook on their course audit form.

Samples of Evidence

1. The teacher selects an approved college-level textbook on their course audit form.
2. The teacher provides the title, author, and publication date of an algebra-based, college-level textbook on their course audit form.

Curricular Requirement 2

The course provides opportunities to develop student understanding of the required content outlined in each of the units described in the AP Physics 1 Course and Exam Description.

Required Evidence

- ☐ The syllabus must include an outline of course content by unit title to demonstrate the inclusion of the required course content listed in the current AP Physics 1 Course and Exam Description.

  Note: If the syllabus demonstrates a different sequence than the units outlined in the current AP Physics 1 Course and Exam Description, the teacher must include the following specific statement: All the content in the current AP Physics 1 Course and Exam Description will be covered in this course.

Samples of Evidence

1. The course will follow the College Board AP Physics 1 Course and Exam Description outline:

   Unit 1: Kinematics

   Unit 2: Force and Translational Dynamics

   Unit 3: Work, Energy, and Power

   Unit 4: Linear Momentum

   Unit 5: Torque and Rotational Dynamics

   Unit 6: Energy and Momentum of Rotation Systems

   Unit 7: Oscillations

   Unit 8: Fluids

2. All the content in the current AP Physics 1 Course and Exam Description will be covered in this course.

   We will cover these chapters of our algebra-based, college-level textbook:

   Chapter 2: Kinematics

   Chapter 3: Two-Dimensional Kinematics

   Chapter 4: Dynamics: Force and Newton's Laws of Motion

   Chapter 5: Further Applications of Newton's Laws: Friction, Drag, and Elasticity

   Chapter 6: Uniform Circular Motion and Gravitation

   Chapter 7: Work, Energy, and Energy Resources

   Chapter 8: Linear Momentum and Collisions

   Chapter 9: Statics and Torque

   Chapter 10: Rotational Motion and Angular Momentum

   Chapter 11: Fluid Statics

   Chapter 12: Fluid Dynamics and Its Biological and Medical Applications

   Chapter 13: Oscillatory Motion and Waves

3. All the content in the current AP Physics 1 Course and Exam Description will be covered in this course.

   The following topics will be covered throughout the year:

   1. Forces: Systems and center of mass, forces and FBDs, Newton's laws of motion, static and kinetic friction, gravitational vs. inertial mass, gravitation, circular motion, spring forces
   2. Kinematics: Instantaneous and average motion, vectors vs. scalars, motion graph, 2D motion, relative motion
   3. Conservation Laws: Work, power, potential and kinetic energy, conservation of energy, linear momentum, impulse changes momentum, conservation of momentum, elastic vs. inelastic collisions
   4. Rotation: Rotational kinematics, connecting linear and rotational, rotational inertia, equilibrium, Newton's first and second laws of rotation, torque and work, rotational kinetic energy, rolling, angular momentum and angular impulse, conservation of angular momentum, orbiting satellites
   5. Oscillations: SHM, frequency and period for SHM, analyzing and representing SHM motion, energy in SHM
   6. Fluids: Density, pressure, fluids and Newton's laws, fluids and conservation laws

Curricular Requirement 3

The course provides opportunities for students to develop the skills related to Science Practice 1: Creating Representations.

Required Evidence

- ☐ The syllabus must include a section labeled "Science Practice 1" describing one assignment, activity, or lab where students create representations that depict physical phenomena.

Clarifying Terms

The following task verbs are commonly associated with Science Practice 1: sketch, draw, or plot.

Samples of Evidence

1. **Science Practice 1**

   Using a toy car, students will collect data and **plot graphs of position vs. time and velocity vs. time**.

2. **SP1**

   In Unit 2: Dynamics, students will **draw a free-body diagram** to determine the net force exerted on an object that will be used to solve for its acceleration.

3. **Science Practice 1**

   Students will **sketch position vs. time, velocity vs. time, and acceleration vs. time** for a mass on a spring experiencing simple harmonic motion.

Curricular Requirement 4

The course provides opportunities for students to develop the skills related to Science Practice 2: Mathematical Routines.

Required Evidence

- ☐ The syllabus must include a section labeled "Science Practice 2" describing one assignment, activity, or lab where students use mathematical routines.

Clarifying Terms

The following task verbs are commonly associated with Science Practice 2: calculate, compare, derive, determine, estimate, or show.

Samples of Evidence

1. **Science Practice 2**

   In many labs, students will be asked to do the following:

   1. Analyze collected experimental data that includes graphing, **calculations, and regression analysis**.
   2. Use functional dependence to determine the **relevance of the slope obtained from the regression analysis** in the context of the experiment.

2. **SP2**

   A lab activity in which students are asked to model the oscillatory behavior of a spring.

   1. **Deriving an expression** from the first principles by solving the second-order DE
   2. **Calculating energy** by employing the principle of conservation of energy
   3. Graphing position vs. time, energy vs. time graphs

3. **Science Practice 2**

   Students **calculate and compare the acceleration** of several unique systems.

Curricular Requirement 5

The course provides opportunities for students to develop the skills related to Science Practice 3: Scientific Questioning & Argumentation.

Required Evidence

- ☐ The syllabus must include a section labeled “Science Practice 3” describing one assignment, activity, or lab where students design experimental procedures, and make and justify claims.

Clarifying Terms

The following terms are commonly associated with Science Practice 3: claim, describe, design, explain, indicate, justify, predict, or state.

Samples of Evidence

1. **Science Practice 3**

   Design an experiment to find the relationship between height and mass for bouncy balls.

2. **SP3**

   Provide students with a ranking task. Students will **make a claim** and **justify their claim with evidence.**

3. **Science Practice 3**

   Pendulum Lab: Students are given different lengths of string, a pendulum bob, a stopwatch, and a ruler. Students will **make a claim** about the relationship between the length of the string and period. Next, students will be instructed **to design an experiment** to determine the relationship between the length of the pendulum and period. Once the data is collected, students will analyze the data to **gather evidence to justify** their original claim or change their claim.

Curricular Requirement 6

Students spend a minimum of 25% of instructional time engaged in hands-on laboratory investigations.

Required Evidence

- ☐ The syllabus must include an explicit statement that at least 25% of instructional time is spent engaged in hands-on laboratory investigations, with an emphasis on inquiry-based labs.

Samples of Evidence

1. Students in this course are engaged in laboratory work more than 25% of the instructional time.
2. Students will spend a minimum of 25% of the course engaged in hands-on laboratory investigations.
3. 25% of course time is spent engaged in hands-on labs.

Curricular Requirement 7

Students engage in hands-on laboratory investigations representative of the topics outlined in the AP Physics 1 Course and Exam Description.

Required Evidence

- ☐ The syllabus must include a title and brief description for each laboratory investigation. The labs listed should be representative of the topics outlined in the AP Physics 1 Course and Exam Description.

Samples of Evidence

1. Labs are done when it is most appropriate for them to be done. Students are given a general question to answer and will work in small groups of two or three to develop their own procedures. Students will have their procedures approved by the instructor before they begin. The course will include the following labs:
    - Vector Lab: Students will analyze vector properties using a vector table.
    - Finding Gravity 1: Students will determine the acceleration due to gravity at school using a pendulum.
    - Finding Gravity 2: Students will determine the acceleration due to gravity at school by dropping a ball.
    - Newton's Second Law Lab: Students will use an air track to determine the relationships between force, mass, and acceleration.
    - Predict the Projectile: Students will predict the landing spot of a projectile moving in two dimensions.
    - Newton's Second Law Lab for Circular Motion: Students will experimentally determine how Newton's second law of motion applies to circular motion.
    - Conservation of Energy: Using an air track, students will verify conservation of energy.
    - What the Mu?: Students will determine the coefficient of kinetic friction using only a book, a meter stick, and a stopwatch.
    - Find the Suspect: Students will predict the velocity of a projectile based on data collected with a ballistic pendulum (conservation of energy and conservation of momentum). They have to match the velocity of the projectile to a suspect to solve a crime.
    - Hooke's Law Lab: Students will experimentally determine Hooke's law using springs and slotted weights.
    - Rotational Motion: Students will use a wheel and axle to explore the concepts of rotational kinematics, rotational dynamics, and rotational energy.
    - Equilibrium Lab: Students will analyze a mobile in equilibrium to determine torques.
    - Gas Law Lab: Students will determine Boyle's law and the ideal gas law with a syringe.
    - Bernoulli's Principle Lab: Students will explore Bernoulli's principle with a three-hole can.
    - Archimedes' Law Lab: Students will determine the density of a liquid using Archimedes' principle with a graduated cylinder, force sensor, and loose weights.

2. **Unit 1 Kinematics**

   Topic 1: Scalars and vectors in one dimension

   Topic 2: Displacement, velocity, and acceleration

   What's the speed? Each student will be given a battery-operated toy, meter stick, stopwatch, and masking tape. Students will collect distance and time data for the battery-operated vehicle. After collecting the data, the student will be asked to create a graph using the data in order to describe the motion of the toy.

   Meeting Point Investigation: In pairs, students develop a way to predict where two battery-powered cars will collide if they are released from opposite ends of a lab table at different times. Students collect data, then make and test their predictions.

   Toy Wind-up Car Motion: Students will collect distance and time data as a toy wind-up car rolls down an incline plane. Students will analyze the data to provide evidence to support their claim about the motion of the toy car.

   Falling Object Motion: Students will drop a mass, collecting distance and time data as the mass falls to the floor. Students will analyze the data to provide evidence to support their claim about the motion of the mass.

3.

1. Constant Velocity Lab: Students design a lab to show an object moves with constant velocity.
2. Constant Acceleration Lab: Students design a lab to show an object moves with constant acceleration.
3. Predict the Projectile: Students have to predict the landing site of a ball when launched from the top of a lab table at a given angle.
4. Mu of the Shoe Lab: Students determine the coefficient of static and kinetic friction between their shoes and several surfaces.
5. Atwood's Machine Lab: Students determine the relationship between total mass and acceleration and the mass difference and acceleration.
6. Flying Cow Lab: Students design a lab to determine the velocity of the flying cow using only a ruler and stopwatch.
7. Impulse Lab: Using video analysis, students determine the impulse of 2 people who are pushing off each other on carts.
8. 1D Collisions Lab: Students design a lab using carts and a track to determine if momentum is conserved and to identify if a collision is elastic or inelastic.
9. Rotational PVC Lab: Students design a lab to determine the moment of inertia (I) of a PVC structure.
10. Streamer Lab: Students predict where to place an unrolling streamer so that it hits the ground at the same time a streamer is dropped from 2 meters.
11. Conservation of Angular Momentum: Students design a lab to determine if angular momentum is conserved when various objects are dropped onto a spinning disk.
12. Barbie Bungee Lab: Students design a lab to predict how many rubber bands need to make up a bungee for Barbie to come closest to the floor without hitting her head.
13. Pendulum Lab: Students design a lab to determine which variables affect the period of a pendulum.
14. Beats Lab: Students design a lab to construct a mass on a spring and a pendulum that have a period made to match the beat of a song.

Curricular Requirement 8

The course provides opportunities for students to record evidence of their scientific investigations in a portfolio of lab reports or a lab notebook (print or digital format).

Required Evidence

- ☐ The syllabus must include an explicit statement that students are required to maintain a lab notebook or portfolio (hard copy or electronic) that includes all their lab reports.

Samples of Evidence

1. After performing the lab, students are expected to submit a lab report electronically or maintain the lab notebook for each experimental activity.
2. Students are expected to keep a lab notebook where they will maintain a record of their laboratory work.
3. All investigations are reported in a laboratory journal. Students are expected to record their observations, data, and data analyses in the laboratory journal.