AP Physics

Merging
AP Physics C (1 BHS course with 2 AP exams) and
AP Physics 1&2 (1 BHS course with 2 AP exams)

Into ***AP Physics*** (1 course with a combination of 2-3 exams)

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Introduction

Most Schools only offer a section *AP Physics C* for their advanced Physics offering, and only prepare students for *AP Physics C: Mechanics.* BHS offered…

BHS Course	AP Physics C	AP Physics 1&2
AP Exams	• *AP Physics C: Mechanics* • *AP Physics C: Electricity & Magnetism* *Representing two collegiate semesters of calculus-based Physics for Physics and Engineering majors*	• *AP Physics 1* *Formerly many algebra-based topics, now just algebra-based Mechanics due to pandemic. Intended to be a full year 11th grade course.* • *AP Physics 2* *Algebra-based Electricity, Magnetism, Thermodynamics, Waves, Modern Physics. Intended to be a full year 12th grade course.*

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Introduction

- CollegeBoard has made many responsive changes to the pandemic, and they have realized that few schools actually separated ***AP Physics 1*** and ***AP Physics 2*** into 2 separate 11th and 12th grade courses as they had hoped.
- BHS has made many changes to the pedagogy over the past 21 years, to keep up with exam changes, changes in educational technology, student engagement and efforts to increase access to the courses.
- We are taking advantage of a set of major changes once more.
- The next section is a historical timeline of the courses and their changes over 21 years.

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AP Physics Timeline at BHS

Pre 1997

Physics 2 AP
Physics 2 H

All in one section

Physics 1 and Physics 1 H was a 11th or 12th grade course.

Only 11th graders in Physics 1 Honor were able to take a Physics 2 course

Mostly White Male students took Physics 2 AP or H

1997-98

Started 9th grade Physics Pilot

4 sections of Accelerated Physics

The idea of AP Physics B offering a more inclusive and robust Physics 2 option began

1998-99

All 9th graders took Physics

Freshman Campus at OLS Year 2

AP Physics B was described to this class of students as a future option

Curriculum development began

2000-01

AP Physics B Begins

1 Section mostly for students in the 1st year of the 9th grade Physics Pilot

1 Section AP Physics C remained

More female students are taking AP Physics than ever before

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AP Physics Timeline at BHS

2001-2017

Consistent results across 2-3 sections among both courses

'Flipped Class' in 2013

Consistently totalling 2-3 sections in both courses over many years

Gradual gains made in diversity and AP exam performance

2013-2014

CollegeBoard changes AP Physics B to AP Physics 1 & AP Physics 2

This was a way to slow the AP Physics B curriculum to two full years. Not applicable to BHS.

This change highlighted the differences in math prerequisite knowledge, and marginalized some gains in diversity.

2016-2017

Increase in enrollment

The BC Calculus prerequisite for AP Physics C was eliminated

More female students, and more students in AASLP request the courses.

Same AP Performance

Totalling 4 sections

2017-2018

AP Physics 1&2
2 sections

AP Physics C
3 sections

Fun Fact on the AP C E&M Tests: There are only 184 Female test takers in Mass this year.

26 Female students @ Lexington
24 Female students @ BHS
No more data on performance is available, and our students scored almost as well as Lexington

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AP Physics Timeline at BHS

2019-20

Pandemic Begins

AP Physics C
2 sections

AP Physics 1&2
2 sections

45 minute exams with 2 questions

More Colleges diminish the influence of the AP Physics 1 exam.

2020-21

CollegeBoard reduces AP Physics 1 curriculum to just Mechanics

Increasing AP Physics 1 obsolescence

2021-22

AP Physics
3 sections

Coding, and other collaborative work is thriving.

Still hard to manage the large amount of the curriculum, but many online resources help.

Still not up to former pace, but curriculum is developing

Future

Focus on access and eliminating more barriers to enrollment.

Use enrollment and student engagement as indicators of success

Consider other options for more optional physics courses

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Overview of the Problem

We have had fabulous success over the decades. There has been more diversity, greater access, greater student engagement, and yet there are several issues that create de facto levels:

1. Students have misunderstood the difference between these two courses
2. This misunderstanding has allowed internalized bias to pervade systematically within the course selection process, creating an unnecessary barrier to calculus-based physics content
3. This misunderstanding has led to unnecessary homogeneity in our student populations
4. The specific topics among the 4 AP exams are hard to choose from

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De Facto Levels

1. For years, students have misunderstood the difference between these two classes.
    - A persistent perception that AP Physics C is “harder” and AP Physics 1&2 is “easier” has led to systemic bias within our course selection process and homoogeneity in the student populations.
    - Despite repeated attempts at messaging campaigns about the actual differences between the classes (which is, in fact, quite small with the main difference being second semester content), we have been unable to break this perception.

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De Facto Levels

2. This misunderstanding has allowed internalized bias to pervade systematically within the course selection process, creating an unnecessary barrier to calculus-based physics content:
    - Students struggle with their identity as math students
        - “I’m only taking AP Calc AB, not BC. Will I feel out of place in AP Physics C?”
        - “I’m taking Calc. Does that mean that I have to take AP Physics C and I’ll be bored in AP Physics 1&2?”
    - Students struggle with their identity as a learner compared to peers
        - “I like physics, but am I really as good as those students in AP Physics C?”, or
        - “I think that I’m going to be ok in AP Physics C, but I’m really really worried that I’ll look dumb, so I probably shouldn’t go ask for help even though I need it; I’ll just drop down to AP Physics 1&2.”

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De Facto Levels

3. This misunderstanding has led to unnecessary homogeneity in our student populations:
    - The previous examples of imposter syndrome are particularly detrimental for female identifying students and students of color.
    - Some students are encouraged to take *AP Physics 1&2* thinking it will be easy. But this is based on bias and imposter syndrome, not ability. These students could have taken *AP Physics C* with some support with Calculus techniques.
    - Some students are encouraged to take *AP Physics C* as the hardest course on their transcript, but this is based on bias not ability. As a result, *AP Physics C* has had predominantly white male students despite the fact that most of the students who actually struggle in the course are white males.

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De Facto Levels

4. Further, even when students do understand that both courses are difficult, they struggle over which class to take for legitimate reasons:
    - “I want to take *AP Physics C* because I want to have an opportunity to use calculus in science class, but I also would rather take the second semester of *AP Physics 2* because I want to learn more about Quantum Mechanics and other kinds of physics.”

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Taking Advantage of the Recent Changes to AP Exams

During the pandemic, CollegeBoard made several changes.

- In 2020 the exams were only two questions. The teachers saw this as an opportunity to collaborate on similar material.
- In 2021, the *AP Physics 1* exam became closely aligned to the *AP Physics C: Mechanics* exam.
- Many more online materials became available for all courses, including *AP Physics C: Electricity & Magnetism* support.

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Taking Advantage

During the pandemic, necessity dictated that the *AP Physics C* and *AP Physics 1&2* teachers collaborate more closely than ever.

- The pandemic allowed both courses to be almost indistinguishable, as we are prepared all students for any combination of the AP Physics exams they may choose to take.
- Teachers created opportunities for both challenge and support in a more heterogeneous grouping, so that the main message is “this is hard, you can do it, we can help” instead of “this is hard, you should struggle alone, and you may be in the wrong course” can be brought to bear for students in either course.
- Teachers created new ways for students to be assessed and challenged.

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Taking Advantage

Additional benefits:

- Scheduling and rescheduling will be much easier if there is only one course instead of two. Counselors appreciate this, and it adds flexibility to scheduling all 12th grade classes.
- Students can collaborate across all sections, and can attend help sessions run by any teacher, and/or student TAs, rather than only the students in each course. This has led to more equity in available support for students to achieve success.

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What Exams Will Students Take?

Students used to only take two of the four exams. **Three are now possible**.

- Students will be prepared for ***AP Physics C: Mechanics*** or ***AP Physics 1*** exams. Students will be encouraged to take the *AP Physics C: Mechanics* exam because the Calculus required is attainable for all students. The necessary calculus is now taught as part of the course.
- All students will take ***AP Physics 2***, as it is more applicable material for students interested in pursuing physics or students who are interested in learning more about what the field of physics might entail.
- All students will have the opportunity to use additional materials provided by our teachers that were used in previous years in order to prepare for the ***AP Physics C: Electricity & Magnetism*** exam. Help sessions will be offered during the second semester for students who elect to self-study for this exam.

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Next Steps

- ❏ We look forward to not traveling between 115/OLS, and returning to a simpler schedule to get time and consistency back
- ❏ We are thrilled to move to 22 Tappan, open the garage doors, and use the new spaces
- ❏ We can’t wait to play with new equipment

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Next Steps

- ❏ Continue to pilot new assessment and grading policies that allow for content mastery
- ❏ Continuous improvement and monitoring of student enrollment and success
- ❏ Adapt online resources to support *AP Physics C: Electricity & Magnetism*
- ❏ Institute a more thorough alum survey system across BHS
  - ❏ How are the coding units helpful?
  - ❏ Are you prepared for all STEM majors?
  - ❏ Have you continued in a STEM major?
  - ❏ Etc.

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Challenges

- Plan to actively work on culture-building around issues of identity
- Restructure the first few units of AP Physics so that the level of rigor builds more gradually and intentionally, while teachers explicitly make time to teach math content.
- If more students feel like they have working unbelievably hard and are feeling successful at the level of challenge they've taken on (and would recommend the course to others), then we'll know that the interventions have successfully created a differentiated heterogeneous learning environment.
- As with all AP courses, the breadth of content material is still too much to fit in before May

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New Catalog Entry: SC4140 Advanced Placement Physics

AP Physics combines the former **AP Physics C** and **AP Physics 1&2** courses. It is a course that provides a systematic introduction to the main principles of physics and emphasizes the development of problem-solving abilities. This course also includes a broad range of topics and is also intended to provide a foundation for students interested in studying physics as a basis for work in the life sciences, medicine, geology, or as a component in a non-science college program with science requirements. Another main focus of this course is in computer modeling via Python. Students will collaboratively apply physics principles to computer coding to learn coding skills while also deepening their understanding of the physics concepts.

The first semester is devoted to classical mechanics, which is typical of a first-semester college course that serves as the foundation in physics for students majoring in the physical sciences or engineering. This is where many coding activities take place to model the motion of objects in constant or changing gravitational fields. The second semester focuses on fluid dynamics, electricity, magnetism, thermodynamics, waves, sound, optics, and atomic and nuclear physics.

This course prepares students for the national *AP Physics C: Mechanics* or the *AP Physics 1* examination. Students can choose with consultation with their teacher. However, students will be encouraged to take the *AP Physics C: Mechanics* exam because the calculus required is attainable for all students. Methods of calculus are used wherever appropriate in formulating physical principles and in applying them to physical problems. The necessary calculus is now taught as part of the course, and calculus is no longer a prerequisite. A knowledge of algebra and trigonometry taught in senior level BHS math courses is required.

Students are also prepared for the *AP Physics 2* examination, which includes topics on fluid mechanics, thermodynamics, electricity, magnetism, waves, sound, optics, and modern physics. All students will take the *AP Physics 2* exam, which is more applicable material for students interested in pursuing any STEM field.

In order to prepare students who elect to take the *AP Physics C: Electricity & Magnetism* exam, this course will supplement their work with additional extensions to electricity and magnetism content of the course. All students will have the opportunity to use the AP Classroom videos and questions as well as classroom materials provided by our teachers that were used in previous years. Help sessions will be offered during the second semester for students who elect to self-study for this exam. Students are expected to take a combination of these AP Examinations. Separate grades are reported for each exam.