AP Physics

Syllabus

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What is Physics?

The world is constantly changing weather patterns come and go, rush hour traffic whizzes by, a river flows, sunlight illuminates the pages of a textbook.

Using logic, mathematics and intuition, physicists look for patterns of order in the events they observe. Physicists have formulated mathematical rules called the *laws of physics* that define these patterns of order. Newton's laws of motion and gravity, and Einstein's famous equation $E=mc^2$, are laws of physics you may have heard about.

Once established, laws of physics change very little over time, because they merely *describe* predictable events in nature. To *explain* these events, physicists and other scientists develop *theories*. A theory consists of one or more mental models that help us to visualize, to think about, and to classify the underlying patterns in the universe. For example, the model of the atom you worked with in chemistry class, with protons and neutrons in the nucleus and electrons orbiting on the outside, is part of modern atomic theory.

Theories *do* change over time as our knowledge and insight grows. Often these changes do not invalidate earlier theories. Rather, new theories tend to expand older theories so that they apply to a wider variety of events and circumstances.

Theories never represent reality perfectly and completely; however, laws and theories combined help us to make sense of the natural world, and to develop new technologies. Computers, cell phones, TVs, cars -- devices you may regard as essential -- were unheard of just a short time ago and could not have been created without gradual advancements in physics over the past two thousand years.

Everything, everywhere, all the time

The laws and theories of physics apply equally to living and nonliving things. There is no distinction between man-made objects and those that come into existence without human involvement. Indeed, physicists attempt to formulate laws and theories that apply everywhere and for all time.

A surprising amount of information about the composition and history of the universe has been discovered by studying light and other forms of radiation from distant objects. Good laws and theories must be consistent with this information, as well as with experiments conducted on earth.

The most trusted theories in physics (and in science generally) have been subjected to a great deal of experimentation and critical analysis, and yet have "passed every test" so far. When experimental results do reveal a flaw in a theory, the theory must be modified or replaced.

In summary, the best ideas in physics are

- *General:* applying to many events in the past, present and future,
- *Concise:* packed with meaning and possibly difficult to understand in detail, but easily written down, and
- *Verifiable*: Tested using experiments that can be repeated.

A wonderful example of a general, concise and verifiable idea in physics is Newton's second law of motion. It takes several months to thoroughly explore the meaning and consequences of this law, but written in mathematical language, the law is remarkably simple: $\Sigma \mathbf{F} = m\mathbf{a}$ (net force on an object equals its mass multiplied by its acceleration).

Classical and Modern Physics

In our class, we will explore the use of classical physics to describe the motion of all kinds of objects. Classical physics was developed in the 1600's by Sir Isaac Newton. It is not "cutting edge," but the ideas in classical physics work so well that engineers still use them today. We will then move on to other topics that involve energy in its various forms: waves, electricity, and magnetism, to name a few.

Selected topics in modern physics, which addresses the weird realm of the very fast and the very small, will occasionally be discussed. Modern physics is essential to the design of most of the electronic devices available to us today.

What is in it for me?

- The study of physics will sharpen your understanding of the world around you.
- Your math skills and reasoning skills will improve. You will become better at solving problems (not just science problems).
- You will learn to organize and analyze data, and to present your conclusions persuasively.

These are important competencies no matter what a person does for a living.

Physics impresses folks who will be making decisions about your future. College admissions officials like seeing physics on high school transcripts. In the minds of most adults, success in physics is proof of an individual's ability to think and to solve problems. Those who go on to major in physics are routinely accepted into medical school, law school and business school. Even if you never study physics again, the presence of this physics course on your transcript will likely prove to be a door-opener.

What is up with your physics teacher?

- 5th year teaching at Capital High
- Has a family with 2 kids
- Has 3 dogs and 2 cats
- Has some letters behind her name
- Has done some things other than teaching; paleontologist, NASA educational outreach, worked on a movie. Was in a punk rock band. This was a long time ago.
- Loves science club and science competitions.
- Loves robotics and robotics club.
- Loves her community theatre group, and really enjoys acting.
- Reads a lot!

What must I bring to class?

- Text
- A pencil, not a pen. I will make mistakes, so will you
- Your calculator
- Your homework
- A three-ring binder with pockets and labs is recommended.

In AP Physics, there will be many class notes, and most math problems will be written in your own notebook.

How will my grade be calculated?

The system used to calculate grades will place emphasis on tests and labs (75%), with other assignments and citizenship making up the remaining 25%.

In AP Physics, practice by completing authentic AP problems is essential and will take the place of some lab work, so tests will comprise a greater percentage of your grade

No matter what course you are taking, you will find tests impossible or extremely difficult if you do not complete your homework conscientiously and on your own, with only occasional help from others or resources on the internet.

How much homework will I get?

Homework assignments include reading of the textbook, problems and lab reports. The time you spend on homework will vary with your understanding of the material and the level of difficulty of the assignment. Some assignments are designed to be completed over a series of nights.

Although not every homework problem will be discussed in class, you will be able to get the correct answers.

If you do not give at least a little time to physics outside of class every day, you will fall behind and develop negative feelings about the class.

If you routinely work in groups on homework or copy the work of others and walk in on test day not knowing whether you can solve physics problems on your own, you are wasting your time.

How will homework be checked?

In AP Physics, there are a variety of ways in which I will check homework. I may walk around at the beginning of class and do a homework check. I may collect an assignment and do either a detailed review or a spot check. Often a comprehensive check of your notebook will be done while you are taking a test. Some of your homework will consist of online assignments requiring mathematical and/or verbal responses. You may not always know in advance how the work is to be checked, but if it is to be turned in, I will tell you.

Depending on the difficulty level of the homework, I will check for effort or for correct answers. If the opportunity is provided, you should correct your work as we go over problems in class, showing both the original work and the correction rather than erasing. Spread your work out so that you have room to make modifications.

How will I find out about my grade?

I will do my utmost to keep your grades current in Powerschool. Checking your grade online is your responsibility. Due to time constraints in class, I will be unable to interrupt proceedings to look up grades for individual students. If class is busy and discussing homework is not part of the plan for the day, work may be placed in a return bin for you to retrieve. However, you get your assignments back, look them over for tips on how to improve your work. Ideas in physics are all related to each other, so you will be using the same skills and relying on the same knowledge repeatedly. Reflecting on past performance, and using repetition to get better at physics, will help you succeed and to earn the course grade you want.

What will happen if my work is late?

For lab reports and other graded assignments, you will lose 20% of the value of the assignment for every day that it is late. Homework problems checked during a test must be turned in on the test day for credit.
Work is due **at the beginning of class**. It is considered late if it is turned in during class or later in the day.

Absence

Unless you have a specific arrangement with me, you will have a maximum of one week to make up labs, tests and quizzes.
Turn in assignments due on a day of absence immediately upon your return to school.
If you are absent on the day before a test or quiz, but present when it is given, you will be expected to take the test or quiz.
If you miss school on the test / quiz day only, be prepared to take the test / quiz on the day you return.

Studying physics in our connected world

Electronic communications methods have connected students in ways that were unimaginable just a short time ago, when I began teaching science. In many respects these changes have been positive. But they also have served to make certain aspects of teaching and learning more difficult.

Students nowadays tend to complete schoolwork in social groups, more frequently or even exclusively. In contrast, physics courses are designed to develop your *individual* ability to understand the world and to think like a scientist. What you can do collectively as a group, or what another person in your group can do, is of little consequence. Shortly, in what will seem like the blink of an eye, you will leave high school and establish new social groups, bringing with you only those skills which have stuck in your own brain.

Group study always has had a place in science learning. Appropriate use of group study leads to better outcomes on assignments and tests. If you are making extensive use of group study but struggling academically, *you are doing something wrong*.

Recommendations:

1. Start all problem sets by yourself. If you use a study group, bring specific questions to it.
2. Ask questions of study partners about how to solve the problems. Do not just "get the answers."
3. Do not expect your study partners to do meaningful teaching. That is not their job and (in most cases) not their area of expertise.
4. Get help from the classroom teacher as a first step, not as a last resort.

A few words on cheating

...Don't do it!

Learning physics is difficult. We need to develop trust (teacher-student and student-student) in order to have an effective working relationship.

Studies indicate that, nationwide, cheating has long been a part of academic culture. What are the consequences?

- Lower grade point average
- Smaller chance of getting into one's preferred college
- Difficulty graduating from high school

You know what cheating is: gaining access to information you are not allowed to have during a test, copying someone else's homework or lab report, cutting and pasting or copying from the Internet, and so forth.

The consequence of getting caught is a zero on the entire test or assignment. In addition, you will lose my advocacy in the college admissions process and at other times when you may need it.

Some students become confused about acceptable and unacceptable collaboration on labs. Acceptable collaboration includes general discussion of a question in person or electronically with your lab partner. However, you must then formulate an answer on your own.

It is never acceptable to share your work product, including drafts and problem solutions, with another student.

If you are looking at or hearing someone else's work product, you are cheating. If you are showing your work product to another student, you are cheating.

It is not acceptable to get an answer from another person, change the words a bit, and write down the answer. Such responses, which do not include independent thought, will adversely affect your grade. All students involved will lose points.

Especially deplorable is the practice of answering questions minutes before a lab is due, with another person's paper in plain view. Both the person copying answers and the owner of the original paper will be considered guilty of cheating.
You will be submitting graded work using a variety of web-based tools. Sharing your username and password with another student, for any reason, is cheating. Never tell your login information to anyone.

Think and write for yourself. Safeguard every assignment so that it is not copied.

Occasionally a student or parent will ask, "They did the lab together, why shouldn't they work together on the report?" For AP students, the answer is rather obvious. The AP exam will include verbal responses in which students are expected to write pieces of a lab report. In-class labs are an authentic rehearsal for that experience. In both cases, groups of students start with the same data, but write about it on their own.

School work completed in groups tends to look more like one person getting "the answer" from another person, rather than the whole being more than the sum of the parts. Too often, "the answer" is wrong because no one took the time to formulate a complete, valid response.

Students will only take with them to the next stage of life that which is in their own heads and hearts. To paraphrase Einstein, I want them to go where the world ceases to be the scene of their personal hopes and wishes -- to observe, admire, and ask -- as free beings. Experiencing the world in the manner of a scientist requires individual reflection and analysis.

Reading: My expectations

I expect you to read all parts of the book that we will cover in class. I recommend that you "read with a pencil," as an older colleague of mine says; that is, you should outline as you read. I will not check to see that you are outlining. The outline is for your use, not mine.

At the outset I will assign specific sections of the book to read, but over time I will transition to a system where I expect you to stay one-half chapter ahead of me. After taking a chapter test, you should read the first half of the next chapter we will cover. Continue to read over the next few days until you have completed the chapter. I will use quizzes to check in and make sure you are doing the reading. Outlining as you read is strongly encouraged.

The Test

Generally, students find that studying physics -- with its emphasis on math skills, reading comprehension, and writing -- serves to improve standardized test scores.

Put simply, the purpose of these courses is to provide you with the opportunity to master physics, so that you can earn a good score (ideally a 4 or a 5) on the AP exam in May. The pace, emphasis, and depth of content in AP Physics is driven by the exam.