12th Grade Physics (Integrated Science IV)

Instructor: David Holt
troublewithphysics@gmail.com

"Any sufficiently advanced technology is indistinguishable from magic"
- Arthur C. Clarke

"Far better is it to dare mighty things, to win glorious triumphs, even though checkered by failure… than to rank with those poor spirits who neither enjoy nor suffer much, because they live in a gray twilight that knows not victory or defeat."
- Theodore Roosevelt

"The most exciting phrase to hear in science, the one that heralds new discoveries, is not 'Eureka!' but 'That's funny…'"
- Isaac Asimov

"No one is dumb who is curious. The people who don't ask questions remain clueless throughout their lives.
- Neil deGrasse Tyson

Course Outline

Integrated Science IV (Physics)

I-Poly curriculum promotes the construction of knowledge through inquiry, experimentation, activity, and problem solving. Integrated Science IV combines the principles of physics, chemistry and life sciences with an emphasis in motion and forces, energy, electricity, magnetism, optics, heat, earth science and the scientific method.
In this class, you will have ample opportunity to shine whether your talents lay in mathematical problem solving, tinkering, or investigating theory. This course is intended to teach you the fundamentals of Physics through solving word problems, inquiry-based experimentation, examining practical applications found in industry, and rigorous study.

Texts:
Conceptual Physics by Paul Hewitt
Make: Electronics by Charles Platt
The Martian by Andy Weir

Classroom Rules/Expectations:

1. Students are expected to be on time, prepared and engaged. They are expected to try and fail. I am not concerned with how fast you learn, just that you do eventually.
2. Students will be respectful. No talking or whispering while others are addressing the class (especially while Mr. Holt is talking)
3. Food is generally not allowed. Drinks are allowed only if they are in a spill proof container.
4. Quizzes can be retaken up to 2 more times (for a total of 3). The highest of the three grades will be recorded. It is not important that you show mastery on your first try. What is important is that you keep at it until you do get it. In the real world there are limits to the number of chances you get to solve problems so you will only get two extra chances to show that you've learned it. Every quiz you take will be different from previous versions.
5. Integrity: You are intelligent, capable, and can make time to harness your skills. If you need help grasping the material, refer to *Office Hours and Getting Help*. If you decide to cheat on an assessment, you will not be eligible for a P in the course.
6. Excusing Yourself: Please let me know before you step out to use the restroom or grab a drink of water. Its important for me to know where you are at all times in case there is an emergency on campus.

Assessment:

A variety of assessment strategies will be utilized to evaluate a student's mastery of the concepts and skills in science. Knowledge acquisition will be monitored through individual and group approaches. Individual evaluation methods include class participation, lecture notebook, lab work, chapter review quizzes, projects and exams. Groups will be evaluated through lab presentations, team assignments and contributions to daily team tasks.

Grading:

Quizzes - 15%
Tests – 30%
Projects – 20%
Labs – 20%
Homework ** – 10%
Class Participation ** – 5%

*** Students will keep a science notebook throughout the year. This notebook will keep handouts, notes and visual aids.*

Office Hours and Getting Help

I believe you can learn the course material and I am on your side. Physics is a uniquely challenging subject because its mastery is only possible through proficiency in both English and mathematics. Because of this, there is a wrong way and a right way to study; which we talk about frequently in class. Other than our class discussions on how to study, here are more suggestions to help you succeed:

1. Rome was not built in a day! Make time to learn physics by studying every night.
2. Visit me during my office hours if you need help.
3. There are other seniors who are doing well in physics who are available to tutor you on a regular basis. Please see me so that you can get connected with a regular tutor.
4. There are a handful of college students who are hired by I-Poly to tutor you in math and physics. Please see Mrs. Marin in the main office for more details.
5. Form a study group with folks from your House.
6. Tutor others. It's the best way to master any material.

Student Outcome Goals:

By the end of this course, students should be able to:

1. Describe Newton's Laws of Motion and predict the motion of most objects.
2. Use Newton's 2nd law of motion to explain why objects of different mass fall with the same acceleration.
3. Relate Newton's 2nd law to circular motion
4. Identify the force-pairs of Newton's third law for cases of both accelerated and non-accelerated motion
5. Differentiate between speed and velocity
6. Understand conservation law are an important part of the way a physicist views nature. And that the two most important laws are those of conservation of momentum and of conservation of energy.
7. Define momentum and state its metric units
8. Explain how momentum is conserved in an isolated system
9. Apply the principle of conservation of momentum to analysis of simple collisions
10. Define work and power
11. Define and differentiate between potential and kinetic energy
12. Explain how potential energy, kinetic energy and work are related in a system
13. Specify how energy conservation applies to machines, giving a quantitative example
14. Understand energy cannot be created or destroyed, merely transferred
15. Describe the heat flow through the process of conduction, convection and radiation
16. Describe the first and second laws of thermodynamics

17. Know how to predict the voltage or current in simple electric circuits constructed from batteries, wires, resistors and capacitors
18. Identify the properties of transistors and their role in electric circuits
19. Solve problems involving Ohm's law and calculate the power (energy per unit of time) dissipated in any circuit element by using the formula that Power = I squared x R
20. Know that the force on a charged particle in an electrical field is QE where E is the electric field at the position of the particle and Q is the charge of the particle
21. Calculate the electric field due to a point charge and recognize that static electric fields have as their source some arrangement of electrical charges
22. Understand that electric and magnetic field contain energy and acto on charged particles or currents as vector force fields
23. Know how to determine the orientation of a magnetic field produced by a current flowing in a straight wire and a coil
24. Changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors
25. Know that the force on a moving particle (with charge q) in a magnetic field is VB sin(a) where a is the angle between V and B(v and B are the magnitudes of vectors v and B, respectively) and the students use the right-hand rule to find the direction of this force
26. Can apply the concepts of electrical and gravitational potential energy in solving problems involving conservation of energy
27. Know that plasmas, the fourth state of matter, contain ions, and/or free electrons and conduct electricity
28. Identify examples and advantages of simple machines and incorporate them in their models
29. Use the scientific method to identify and research the problem, form a hypothesis and perform an experiment to see if the hypothesis works, students will analyze and conclude the data of an experiment
30. Have an overview of the Earth and other planets
31. Understand the structure of a telescope
32. Describe the formation of the solar system
33. Understand the discovery, the impact and the mass extinction of the asteroids
34. Describe our milky way galaxy
35. Explain the nuclear fusion process

Course Content: *** This is a general roadmap showing the order of topics that we will cover in this class. It is possible that we will spend extra time on some subjects and drop others depending on time constraints and student need.*

Topics of Study in Order:

1. About Science (Chap 1 Hewitt)
2. Electricity and Magnetism (Chaps 32-37 Hewitt)
    a. Electrostatics
    b. Electric Fields and Potential
    c. Electric Current
    d. Electric Circuits
    e. Magnetism
    f. Electromagnetic Induction
3. Mechanics (Chaps 2-16 Hewitt)
    a. Linear Motion
    b. Projectile Motion
    c. Newton's Laws
    d. Momentum
    e. Energy
    f. Circular Motion
    g. Gravity
    h. Rotational Mechanics
    i. Universal Gravitation
    j. Gravitational Interactions
    k. Satellite Motion
    l. Space and Time
    m. Special Relativity - Length, Momentum, Energy
4. Heat (Chaps 21-24 Hewitt)
    a. Temperature, Heat, Expansion
    b. Transfer
    c. Phase Changes
    d. Thermodynamics
5. Sound & Light (Chaps 25-31 Hewitt)
    a. Vibrations and Waves
    b. Sound
    c. Light
    d. Color
    e. Reflection and Refraction
    f. Lenses
    g. Diffraction and Interference