Honors Conceptual Physics
2008-2009 Academic Year
Mr. Carriuolo

COURSE INFORMATION

This is a course in conceptual physics. In this course, we will study the following topics, in the order in which they appear below:

--States of Matter (Solids, Liquids, Gases)
--Temperature and Heat
--Energy and Power
--Thermodynamics and Heat Engines
--Motion
--Forces and Newton's Laws of Motion
--Static Electricity
--Electric Current and Circuits
--Magnetism
--Waves
--Sound
--Light
--Momentum (How much "umph")
--Rotational Motion
--Quantum Mechanics (Waves are particles! Particles are waves!)
--Atomic Physics
--Nuclear Physics
--Gravity
--Projectile and Satellite Motion (Flying things and orbiting things)
--Relativity (the stuff Einstein is famous for!)

As you can see, physics is a science that covers a very wide range of topics. I hope that through this course, you will see how physics surrounds you all the time and everywhere in your life, and in beautiful ways, too!

In physics, there are two primary types of things that we study: concepts and problem solving. Concepts are scientific ideas that we can easily discuss in words; they are useful in understanding what is happening in a given situation. Problem solving is about using math to find numerical answers to specific questions. Both are very important in physics. However, because this is a CONCEPTUAL physics class, we will cover these topics with as little math as possible. We're doing that for two reasons. The first reason is that you're in the 8th Grade, and it isn't fair for me to expect you to be really advanced in algebra yet, especially at the beginning of the year. I don't want you to lose interest in the joys of physics just because you're afraid of math. The second reason is that even if you were good at math, you would still need to understand first what's actually going on in a physical situation. What good does it do us to calculate something without knowing what it means? What affects what, and in what ways? The concepts are often much

more useful in helping us out in everyday tasks than problem solving is, whereas problem solving can be more useful in experiments in a lab or perhaps in constructing things on the job if you work for an architect or a designer, for example.

In order to make sure that you are understanding the concepts that we cover in this course, we will have five-question, multiple choice quizzes the day after we finish each chapter. This is to keep the concepts fresh in your memory. We'll usually spend three or four days on each chapter, so it means that there will be many of these quizzes during the course of the year. Because there are so many of them, don't panic if you have a bad quiz or two; it won't affect your grade too much in the end.

Another thing that will contribute to your grade in this course will be a series of short essay-like things called "Concept Quests." They will test your understanding of the concepts in an essay-like manner, unlike the quizzes mentioned above.

We will perform several lab experiments in this course. Sometimes you will need to write a lab report. We will go over in class how these reports should be written. Lab reports will always be due after a weekend and will be returned to you after the following weekend. This way, you will have the time to write good reports, and I will have time to correct them thoughtfully.

Finally, there will be a test at the end of each unit. I try very hard to make my tests fair. If you know your stuff well, then you will probably do well; if you do not know your stuff well, then you will probably not do well.

Because this is the honors section of conceptual physics, you will be challenged more than students in the regular section of conceptual physics on concept quests, quiz questions, and test questions. The questions assigned will generally require some deeper thought.

Academic Honesty: It is your responsibility to do your own work. You may NOT work together with other students on anything that you hand in for this course (during class or outside of class) except for the lab reports, where you may work together, but you must still hand in your own lab report in the end. Copying another student's work is a serious offense and will result in an Honor Code violation. You may, however, study together in preparation for tests and quizzes.

Grade Breakdown: The following is the grade breakdown for the Fall Trimester:

Quizzes: 15%
Concept Quests: 20%
Tests: 30%
Lab Reports: 10%
Final Exam: 25%

Grade breakdowns for later trimesters will be announced at the beginning of each semester.

Finally, please feel free at any time to see me for extra help. I am free during B, C, and X Blocks, and I will usually be available all five school days each week during the afternoon academic help period. You might also be able to catch me at breakfast for a quick question or two. If you can't find me in person, then feel free to send me an email at mcarriuolo@lindenhall.org. (Be careful to check your spelling. . . .) If you'd like to have a conversation rather than interacting over email, then you may call my cell phone number, (401) 338-0572. Please do not call me after 10:00 P.M. (it's a general rule of politeness) or before 7:00 A.M.

Week	**Topics**	**Chapters in Hewitt's *Conceptual Physics* Text**
August 26-29	Introduction, Solids	18
September 2-5	Liquids	19
September 8-12	Gases, Test	20
September 15-19	Temperature, Thermal Expansion, Heat, Heat Transfer	21, 22
September 22-26	Heat Transfer, Change of Phase	22, 23
September 29 - October 3	Test, Energy	8
October 6-10	Power, Thermodynamics	8, 24
October 13-17	Test, Motion, Newton's 1st Law of Motion, Forces	2, 4
October 20-24	Newton's 2nd and 3rd Laws, Test	5, 6
October 27-31	Electrostatics, Electric Fields	32, 33
November 3-7	Electric Fields, Electric Potential, Review	33
November 10-14	Review, Exams	
November 17-21	Current, Circuits	34, 35

Week	Topics	Chapters in Hewitt's *Conceptual Physics* Text
December 1-5	Magnetism, Electromagnetic Induction	36, 37
December 8-12	Electromagnetic Induction, Test, Oscillatory Motion	37, 25
December 15-19	Waves, Sound	25, 26
January 6-9	Sound, Test	26
January 12-16	Light, Color	27, 28
January 19-23	Color, Reflection, Refraction	28, 29
January 26-30	Refraction, Lenses, Optics	29, 30
February 2-6	Diffraction, Interference, Test	31
February 9-13	Momentum, Circular Motion	7, 9
February 16-20	Circular Motion, Center of Gravity, Rotational Motion	9, 10, 11
February 23-27	Rotational Motion, Test	11
March 2-6	Quantum Mechanics, Atomic Physics	38
March 9-13	Atomic Physics, Fluorescence, Phosphorescence, Incandescence	38, Other Edition
March 16-18	Test	
March 30 - April 3	Nuclei, Radioactivity, Fission	39, 40
April 6-9	Fission, Fusion, Test	40
April 14-17	Gravity I	12
April 20-24	Gravity II, Projectiles	13, 3

Week	Topics	Chapters in Hewitt's *Conceptual Physics* Text
April 27 - May 1	Projectiles, Satellites, Test	3, 14
May 4-8	Special Relativity	15, 16
May 11-15	Review for Final Exam	

ROUGH TOPICAL OUTLINE

I. States of Matter
- A. Solids
  1. Cubic Lattices
  2. Density
  3. Elasticity
  4. Tension and Compression
  5. Scaling, Surface Area to Volume Ratios
- B. Liquids
  1. Weight
  2. Pressure
  3. Buoyant Force
  4. Floating
  5. Pascal's Principle & Hydraulic Lifts
- C. Gases
  1. Layers of Earth's Atmosphere
  2. Mercury Barometers
  3. Suction and Atmospheric Pressure
  4. Boyle's Law
  5. Bernoulli's Principle
  6. Hot Air Ballons and Airplanes

II. Heat
- A. Temperature
  1. Temperature Scales
  2. What Temperature of a System Means
- B. Heat
  1. Where Heat Flows
  2. Specific Heat
  3. Calories
  4. Climates Across the Continent
- C. Thermal Expansion
- D. Heat Transfer
  1. Conduction
  2. Convection
  3. Radiation
     a. Blackbody Radiation

- b. Greenhouse Effect & Global Warming
- 4. Newton's Law of Cooling

E. Change of Phase
- 1. Evaporation
- 2. Condensation
- 3. Boiling
- 4. Freezing
- 5. Latent Heat

III. Energy

A. Work and Energy
- 1. Work
- 2. Power
- 3. Kinetic Energy
- 4. Potential Energy
- 5. Conservation of Energy
- 6. Efficiency
- 7. Sources of Energy

B. Thermodynamics
- 1. First Law of Thermodynamics
- 2. Types of Thermodynamic Processes
  - a. Adiabatic
  - b. Isothermal
  - c. Isochoric
- 3. Second Law of Thermodynamics
- 4. Heat Engines and Refrigerators
- 5. Entropy

IV. Motion and Forces

A. Motion
- 1. Distance v. Displacement
- 2. Speed v. Velocity
- 3. Acceleration
- 4. Acceleration Due to Gravity
- 5. Air Resistance

B. Force
- 1. Newton's First Law: Inertia
- 2. Newton's Second Law
  - a. Mass and Acceleration
  - b. Friction
- 3. Newton's Third Law

V. Electricity and Magnetism

A. Static Electricity
- 1. Electric Charge
- 2. Electric Force
- 3. Conductors and Insulators
- 4. Induced Charge

B. Electric Fields

1. Electric Fields
2. Electric Potential Energy
3. Voltage
4. Van de Graaf Generators

C. Current
1. Electric Current
2. Batteries
3. Resistance
4. Ohm's Law
5. AC/DC
6. Electric Power

D. Circuits
1. Series Circuits
2. Parallel Circuits
3. Compound Circuits

E. Magnetism
1. Magnets and Magnetic Fields
2. Domains
3. Magnetic Fields and Electric Currents
4. Magnetic Force

F. Electromagnetic Induction
1. Electromagnetic Induction
2. Faraday's Law
3. Transformers and Power Transmission

VI. Waves

A. Vibrations and Waves
1. Periodic Motion
2. Waves
a. Period, Frequency and Wavelength
b. Wave Speed
c. Transverse Waves
d. Longitudinal Waves
3. Constructive and Destructive Interference

B. Sound
1. Pressure Waves
2. Speed of Sound
3. Loudness
4. Pitch
5. Standing Waves and Resonance
6. Closed-Pipe Resonators and Open-Pipe Resonators (Musical Instru ments)

VII. Light

A. What Light Is
1. Light as Electromagnetic Waves
2. The Speed of Light
3. The Electromagnetic Spectrum

4. Transparent Materials
5. Opaque Materials
6. Polarization

B. Color
1. Color Spectrum
2. Color by Reflection
3. Combining Colored Lights
4. Complementary Colors
5. Combining Colored Pigments
6. Why the Sky Is Blue
7. Why Sunsets Are Red
8. Why Water is Greenish Blue

C. Optics
1. Reflection
2. Mirrors
a. Concave Mirrors
b. Convex Mirrors
3. Refraction
4. Dispersion
5. Rainbows
6. Total Internal Reflection
7. Lenses
a. Concave Lenses
b. Convex Lenses

D. Diffraction and Interference
1. Diffraction Through Slits
2. Interference
3. Thin Films

VIII. Momentum and Circular Motion

A. Momentum
1. Momentum
2. Impulse
3. Conservation of Momentum
4. Collisions

B. Circular Motion
1. Rotation v. Revolution
2. Rotational Speed
3. Centripetal Force
4. Center of Gravity
5. Toppling

C. Rotational Dynamics
1. Torque
2. Rotational Inertia
3. Angular Momentum
4. Conservation of Angular Momentum

IX. Modern Physics

- A. Quantum Mechanics
    1. Quanta
    2. Photoelectric Effect
    3. Wave-Particle Duality
    4. deBroglie Wavelengths
    5. Models of the Atom
- B, Photon Emission
    1. Incandescence
    2. Fluorescence
    3. Phosphorescence
    4. Lasers

X. Nuclear Physics
- A. The Nucleus
- B. Isotopes
- C. Radioactive Decay
- D. Half-Life
- E. Carbon Dating
- F. Nuclear Fission
- G. Fission Reactors
- H. Mass-Energy Equivalence
- I. Nuclear Fusion

XI. Gravity
- A. Universal Gravitation
- B. Gravitational Fields
- C. Tides
- D. Black Holes
- E. Projectile Motion
- F. Satellite Motion

XII. Special Relativity
- A. The Speed of Light
- B. Time Dilation
- C. Length Contraction
- D. Mass-Energy Equivalence
- E. Relativistic Momentum
- F. Relativistic Energy