

KINGSBOROUGH COMMUNITY COLLEGE  
THE CITY UNIVERSITY OF NEW YORK

DEPARTMENT OF PHYSICAL SCIENCES

SCIENCE 25 LECTURE SYLLABUS

The overall objective of the course is to enlighten and make relevant conceptual links with the principles of chemistry and physics and whenever possible show their relation to appropriate aspects of nursing, medicine, biology and daily living.

TEXT: Hewitt, P., Suchocki, J., Hewitt, L. **CONCEPTUAL PHYSICAL SCIENCE 3<sup>rd</sup> Ed.**  
Pearson Addison Wesley. 2004.

<u>Chapter</u>	<u>Title</u>
HSH 0	Prologue

So what is science all about and why is it necessary for you to take this course.

<u>Chapter</u>	<u>Title</u>
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HSH App "A"	Measurements
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: Topics to be covered; skills to be learned.

Metric system; conversions from metric to English and visa versa; derived units; density, temperature scales; learn how to convert patient/ client's weight, height, and temperature from  $^{\circ}\text{C}$  to  $^{\circ}\text{F}$  and visa versa; learn how to calculate density of a medication and how to use density to calculate mass and volume; learn to determine patient /client's medication if, dosage per kg is given; review of fractions and algebra.

<u>Chapter</u>	<u>Title</u>
HSH 1 / App. "B"	Forces

Motion; speed, velocity and acceleration;

<u>Chapter</u>	<u>Title</u>
HSH 2/ App."C"	Newton's Laws of Motion

Newton's laws of motion; Force; force as a vector; concurrent forces; learn vector addition, vector addition by parallelogram method; resultant and equilibrant forces, tail-to-tail vector addition; head-to-tail vector addition. The six Purposes of Traction, types of traction used e.g. Russell traction, Buck's extension traction, and Skin traction.

Chapter      Title

HSH 3      Momentum and Energy

Definition and physical examples of work energy and power. Discussion of types of energy. Energy conversion and conservation. Units of measurements. Power and energy applications in biological systems. Metabolic energy concepts. Graphical concepts.

Chapter      Title

HSH 4      Newton's Law of Universal Gravitation

Curvilinear motion, the law of universal gravitation; clinical applications of gravity; advantages and disadvantages of weightlessness; center of gravity; stability of a body; applications to good body mechanics; learn to perform simple calculations on problems involving motion and graphical analysis.

Definition of machine. Examples of simple machines (Levers, Inclined planes, pulleys).

Concept of Force, transference of energy. Frictional force, is it useful?

Vectors and Tensors - (Concept of torque with applications to body movement(s)).

Correlation between levers and human skeletal structure. Mechanical Advantage.

Chapter      Title

HSH 5      Projectile Motion

How gravity affects an object as it passes through the air.

Chapter      Title

HSH 6      Fluid Mechanics

Density, Buoyancy, Flotation, Boyle's Law and other gaseous phenomena.

Hydrostatic pressure, hydraulics, Pascal's Law with applications to nursing - i.e. (therapeutic irrigation and suction - theory and practice.)

Viscosity and capillary action with applications to hematology -diagnostic procedures, siphons; tidal drainage, gastric lavage.

Chapter      Title

HSH 7      Thermal Energy and Thermodynamics

What is temperature? What is heat? Heat capacity ...? Thermodynamics, the musical group that atoms dance to.

Chapter      Title

HSH 8      Heat Transfer and Change of Phase

How does heat travel from one place to another. What happens to a substance when it absorbs heat.

Chapter      Title

HSH 9      Static and Current Electricity

The students should know:

1. That Electricity (dynamic) is the flow of charges..
2. That Electricity (static) is the collection of electric charges.
3. That Ohm's Law  $E = IR$  expresses the relationships between electric pressure (voltage), current (amps)(charges/second) and resistance (ohms). Be able to solve simple problems.
4. Materials are divided into conductors and insulators based upon their ability to conduct an electric current.
5. Wet bodies are less resistive to electric flow than dry bodies.
6. The danger of electrocution is related to the electric current flow, not voltage. Even a relatively low current 0.01- 0.2 amps can result in ventricular fibrillation.
7. In the operating room, humidity is kept relatively high and equipment is grounded as well as special materials used to minimize buildup of static electricity which could cause a spark and probably cause anesthetics to explode.
8. Safety procedures against short circuits leading to fires include use of ground fault interrupter and circuit breakers.
9. Application of magnetism and the production of electricity are found in the generator and the electric motor.
10. The right hand rule ~which explains the relation between an electric current through a conductor, its direction, and the direction of magnetic lines perpendicular to the electric flow.

Chapter      Title

HSH 10      Magnetism and Electromagnetic Induction

Some of the uses of magnets will be explored.

Chapter      Title

HSH 11      Waves and Sound  
Lots of wiggling and Jiggling going on.

Chapter      Title

HSH 12      Light Waves  
  
The long and short of it all. Roy G. Biv rules.

Chapter      Title

HSH 13      Properties of Light  
Can you see yourself? Are you really at that position? Focus man, focus.

Chapter      Title

HSH 14      Atoms and the Periodic Table  
  
The atom its size and weight; fundamental subatomic particles; learn to diagram the structure of an atom given atomic number and mass number; isotopes; arrangement of electrons in the atom; electron levels; the periodic table; learn to use the periodic table to predict number of outermost electrons and number of electron shells.

Chapter      Title

HSH 15      Atomic Models  
The study of the atom on a microscopic level.

Chapter      Title

HSH 16      The Atomic Nucleus  
  
Discovery of radioactivity; types of radiation; alpha, beta, gamma radiation; nuclear reactions; balancing nuclear reactions; natural and artificial radioactivity; units of radiation; detection and measurement of radiation; radioisotopes; half-life; radioisotopes in medicine; x-ray therapy and diagnostic use; ultrasonography; magnetic resonance imaging; biologic effects of radiation; aspects of protection from radiation; sources of radiation; nuclear energy; nuclear fission, chain reaction nuclear fusion.

Chapter            Title

HSH 17/21/23 Elements of Chemistry/ Chemical Reactions/ Oxidation and Reduction

This chapter will give you an overview of the different forms of energy and an introduction to the study of matter. You should know the four states of matter; solid, liquid, gas, and plasma. What are physical and chemical properties? The meaning of an equation; balancing chemical equations; types of chemical reactions; *combination, single replacement, double replacement (metathesis), (neutralization), decomposition, and combustion*, reaction rates and factors affecting them; practical applications of the various factors.

Chapter            Title

HSH 18            Mixtures; Liquids; Liquid Mixtures

Solutions, parameters affecting solubility, Polar and non- polar solvents and solutions. Solution concentration - measurement systems. Solution preparations. Physical properties of solutions - (osmotic pressure, boiling point, freezing point). Diffusion - Membrane equilibrium, Tonic solutions, dialysis. Suspensions - (Colloids, Adsorption, Tyndall effect, Brownian movement, Emulsions).

Chapter            Title

HSH 19/20        Chemical Bonding; Molecular Attractions

Molecules; stability of the atom; symbols and formulas; electron-dot structure; foundation of ions; ionic bonds, polyatomic ions; writing of formulae when ions are given; covalent bonds; multiple bonds; electronegativity; polar and nonpolar covalent bonds; oxidation numbers; learn to calculate oxidation number from formula; molecular weights; calculation of molecular weights from atomic weights; learn how to write electron dot structures of simple covalent molecules.

Chapter            Title  
HSH 22            Acids, Bases and Salts

Properties of Acids, Bases, and Salts  
Common Acids and Bases - (Physiological and environmental).  
Medicinal Acids and Bases.  
Titration of Acids and Bases  
pH - (definition, medical and physiological indications). Ionization of Water.  
Biological effects of changes in the acid/ base environment.

The chemistry of the hydrocarbons is the basis for most of the organic and biological chemistry that is encountered later. Hydrocarbons are flammable, covalent compounds that are insoluble in water and less dense than water.

Chapter 24 continued:

Objectives - The student should know:

1. That hydrocarbons are compounds of only two elements: hydrogen and carbon.
2. Three reasons why carbon forms so many compounds.
3. That alkanes are hydrocarbons with only single bonds (saturated).
4. How to name the first ten normal alkanes plus isobutane given the structure, or to write the structure given the name.
5. How to recognize compounds that are homologs (they differ by a  $\text{CH}_2$  unit).
6. That alkenes are hydrocarbons with a carbon-to-carbon double bond.
7. That alkynes are hydrocarbons with a carbon-to-carbon triple bond.
8. That alkenes and alkynes are unsaturated hydrocarbons.
9. How to have the simplest alkene (ethylene), given the structure or to recognize the structure, given the name.
10. How to name the simplest alkyne (acetylene), given the structure or to write the structure, given the name.
11. That cyclopropane is used as an anesthetic.
12. How to use valence rules to recognize a correct structure from a list of structures.
13. That hydrocarbons are frequently used as solvents for fats, oils, waxes and other substances of low polarity.
14. How to select compounds which are isomer from a list of structures.

15. That hydrocarbons are flammable covalent compounds which are insoluble in water and less dense than water.
16. Be able to write balanced equations for the addition of hydrogen to ethylene or acetylene to form ethane.
17. How to recognize alkane, alkene, alkyne from the empirical formula using  $C_nH_{(2n+2)}$ ,  $C_nH_{2n}$ , and  $C_nH_{(2n-2)}$ .
18. That liquid hydrocarbons cause chemical pneumonia when inhaled by dissolving fat-like material from the cell membranes.
19. That the lighter liquid alkanes (like gasoline) dissolve body oils and thus can lead to dermatitis. The heavier liquid alkanes are oils and can act as skin softeners. (Mineral oil and petroleum jelly, serve as emollients)

<u>Chapter</u>	<u>Title</u>
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HSH 24	Organic Compounds
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Once the names and structures of a variety of hydrocarbons are known, the student is ready to learn about other interesting organic compounds. Keeping in mind the valence rules learned earlier, the student should learn the functional groups encountered in this chapter. Then the student can learn the new compounds by considering them as derivatives of alkanes in which one or more hydrogen atoms are replaced by the functional groups.

Objectives

The student should know:

1. How is use valence rules to recognize a correct structure from a list of structures.
2. How to recognize the functional group of a(an):
 

(a) alcohol	(b) acid	(c) amine	(d) aldehyde
(e) ketone	(f) amide	(g) ester	(h) ether
3. That methyl alcohol is the most dangerous alcohol to drink.

4. That ethyl alcohol is the least toxic alcohol.
5. How to name alcohol with 1 to 3 carbon atoms given the structure or to write the structure given the name.
6. How to name ketones, acids, esters, amines, ethers give the structure or to write the structure given the name.
7. That ethyl alcohol is not a stimulant; you don't get high on booze.
8. That acetic acid is the main component of vinegar.
9. That some commonly prescribed drugs like Inderal (Propranolol) used to treat hypertension and heart arrhythmia and to relieve angina contains the functional group of an alcohol and also that of an amine.
10. That Ibuprofen (Motrin), an anti-inflammatory drug (3rd most widely prescribed) contains functional types of acid.
11. That Aldomet (Meth dopa) an antihypertensive drug is an amino acid.
12. That diabetic patients can be diagnosed by the presence in blood or breath. (Acetone is a metabolite).
13. That glucose in urine can be detected by a test for aldehydes called the Fehling Test, which involves the reducing action of aldehydes on  $\text{Cu}(\text{OH})_2$  converting it to a red precipitate of  $\text{Cu}_2\text{O}$ .
14. That trihydric alcohols like glycerin exist.
15. That esters like Nitroglycerin which are the product of an organic alcohol and an acid, have beneficial use such as relieving angina. Phenyl mercuric acetate is used to disinfect instruments and as an antiseptic on cutaneous and mucosal surfaces.
16. That primary alcohols can be oxidized to aldehydes and then to acids.
17. That secondary alcohols can only be oxidized to ketone.
18. That tertiary alcohols can not be oxidized at all.
19. How to recognize primary, secondary and tertiary alcohols from their structures.
20. The simplest aldehyde (formaldehyde) or methanol is used as a germicide (formalin) in water.

21. The two carbon aldehydes, (acetaldehyde) can polymerize to paraldehyde, which depresses the central nervous system.
22. That ethyl ether is formed by the dehydration of alcohol.
23. That ethyl ether has been used as a general anesthesia; is an excellent muscular relaxant with little effect on the rate of respiration or pulse-rate but is irritating to respiratory membranes, may cause nausea and is flammable. For these reasons it has been replaced by non-flammable, non-irritating anaesthetics such as halothane and nitrous oxide.
24. That nearly all organic compounds burn (exception: chlorinated compounds such as  $\text{CCl}_4$ )
25. That ethyl alcohol has the ability to coagulate protein which enables it to act as a disinfectant by penetrating bacterial walls and coagulating the DNA. It is used in sponge bath because of its cooling effect due to high evaporation rate.

<u>Chapter</u>	<u>Title</u>
HSH 24	(Cyclic) Aromatic Compounds

Aromatic compounds contain Benzene; a six sided carbon ring with a hydrogen at each corner and 3 alternating double bonds. Benzene reacts by substitution of the hydrogen atom(s).

1. Prefixes of ortho, meta, and para are used to describe di-substituted products of Benzene. Be able to recognize and name these isomers.
2. The simplest ring alcohol is phenol (carbolic acid). Phenol is used as a disinfectant of surgical instruments.
3. Cresols are methyl derivatives of phenol. They are better antiseptics than phenol and are less toxic.
4. Benzoic acid is a benzene ring with a carboxyl ( $\text{COOH}$ ) group attached. Benzoic acid may be produced by the oxidation of toluene.

5. Acetyl salicylic acid (aspirin) is an analgesic, an antipyretic is used in the treatment of colds, headaches, minor aches and pains. Aspirin is contraindicated after surgery.

6. Naphthalene contains two benzene rings fused together.

7. Anthracene and phenanthrene contain three benzene rings joined together. Many carcinogenic compounds have been found to be related to benzene and its analogs.

8. Benzene is different from Benzine which is an aliphatic compound used in dry cleaning and paint thinners.

**Additional topics to be included:**

<u>Chapter</u>	<u>Title</u>
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Handout	Gas Laws
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Kinetic Molecular theory - Pressure, volume, temperature measurement.

Gas Laws (Boyle's, Charles', Combined, Graham's, Henry's, Dalton's)

Pulmonary function and mechanics. Pulmonary pathology and treatment. Air pollution.

<u>Chapter</u>	<u>Title</u>
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Handout	Oxygen
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Occurrence, physical and chemical properties; preparation, medical uses, guide lines for medical administration of oxygen and other gases.

Noxious and toxic gases.

Use of oxidation number to predict formula of acid.

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