

EDUCATIONAL ASSIGNMENT for JOSEPH JOHN WUNDERLICH for his 3rd trimester of 10th grade

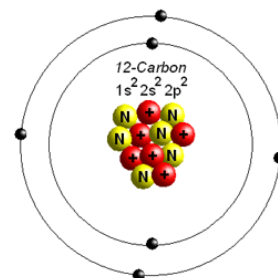
This assignment covers the following Educational Objectives (Subjects marked with a "■" are the main subject, and those marked with an "□" are secondary subjects):

- 1. READING (ENGLISH)
- 2. WRITING (ENGLISH)
- 3. ALGEBRA 2
- 4. CHEMISTRY
- 5. WORLD HISTORY
- 6. LATIN II
- 7. WORLD CULTURAL ARTS
- 8. PHYSICAL EDUCATION

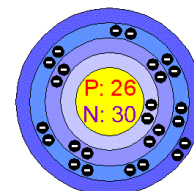
ASSIGNMENT: Recall your father's lecture on Atoms, Molecules, Crystal Lattice Structures, and Semiconductors (excerpt attached to the end of this document), and other teachings on Chemistry & Physical Science, then research and write about how Carbon, Iron, and other elements are combined to make different Steel Alloys

JOSEPH'S WORK:

Carbon is an atom that bonds easily with other atoms, over 10 million compounds in fact can be made with carbon. It makes up graphite and diamond, one being one of the weakest substances, but the latter being one of the strongest. In the production of steel and other alloys, carbon content determines the strength and flexibility of the alloy.

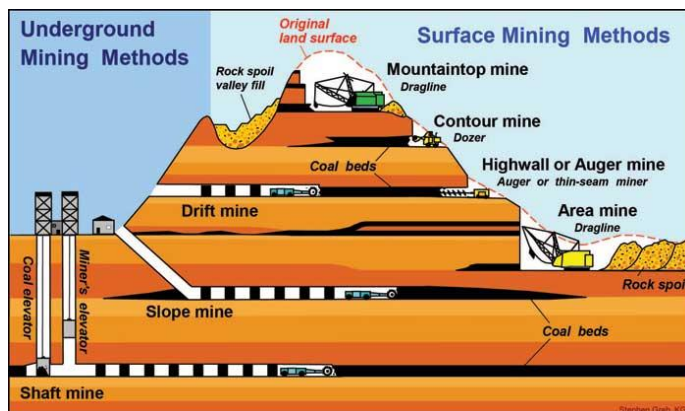


Iron is an element used as a main ingredient in most metal production around the world. Steels and low carbon iron alloys along with other metals (alloy steels) are by far the most common metals in industrial use.



Steel is an alloy made primarily from Iron and Carbon. Other elements such as Chromium increase rust resistance and Nickel for ductility (flexibility).

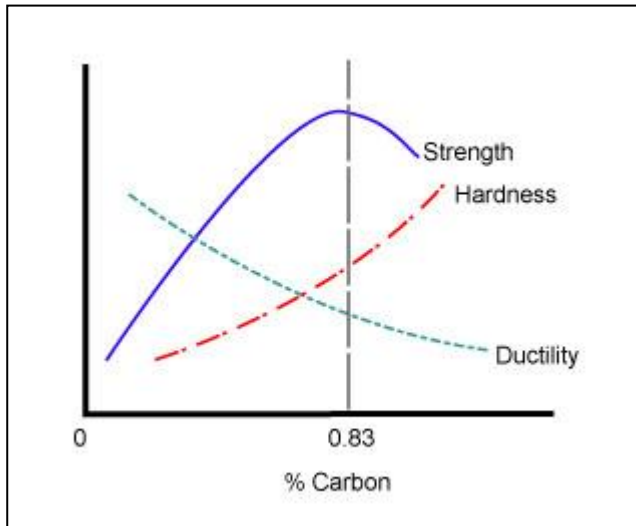
The ingredients used in steel must be dug out of the ground through mines. One of which is coal, a largely exported good in Pennsylvania. A surface coal mine is shown below to the left. Though this form of mining is safer, it leaves a large toll on the ground. Other methods of mining are shown below to the right.



Once materials are acquired, the process of combining the elements includes both chemistry and manufacturing. The chemistry includes balancing equations and understanding $PV=nRT$. The Manufacturing requires melting, forging, folding, casting, quenching, cutting, rolling, and drawing through a dye.

The types of Steel I'm studying are for architectural metal accents and beams, weaponry such as firearms and swords, and plumbing.

For architectural beams and columns the variables are strength, ductility, and corrosion resistance. Kinds of strengths are compression, tensile, sheer, and flexural. The carbon content is the most important ingredient for determining the type of strength the steel will have.



This graph shows an ideal amount of carbon for maximum strength at 0.83% and how ductility is lost for the price of hardness and strength to a point.

Adding Nickel increases Ductility

A katana is a balance of strength, precision, and balance of weight. The Japanese smelting furnace for katanas is called a tataru. Local iron sand has less impurities such as sulfur and phosphorous than typical iron ores. A katana never becomes completely molten. A precise amount of carbon content is there at an atomic level to aid in shock absorption. The steel is folded over 5000 layers per 1 cm of steel. These layers make a wavelike pattern. The harder steel is wrapped around a softer core in the sword made in this video: https://www.youtube.com/watch?v=VE_4zHNcieM

Shown to the right are the different types of layering used in most katanas

The harder steel is 0.7% carbon. The stronger steel can be sharpened.

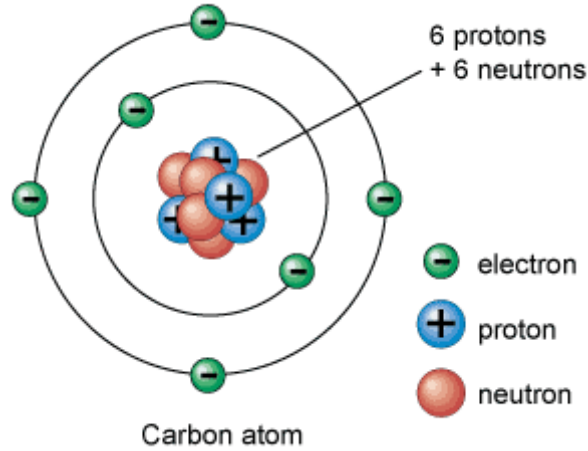
Hagane (Hard Steel)	Kawagane (Medium Steel)	Shigane (Soft Steel)
<p>Maru</p>	<p>Kobuse</p>	<p>Honsanmai</p>
<p>Shihozume</p>	<p>Makuri</p>	<p>Wariha Tetsu</p>
<p>Orikaeshi Sanmai</p>	<p>Gomai</p>	<p>Soshu Kitae</p>

Maru	not laminated; poorest method
Honsanmai	most common lamination method
Kobuse	method used on swords from WW2 period
Soshu Kitae	seven layers method; used by famous sword smith, Masamune

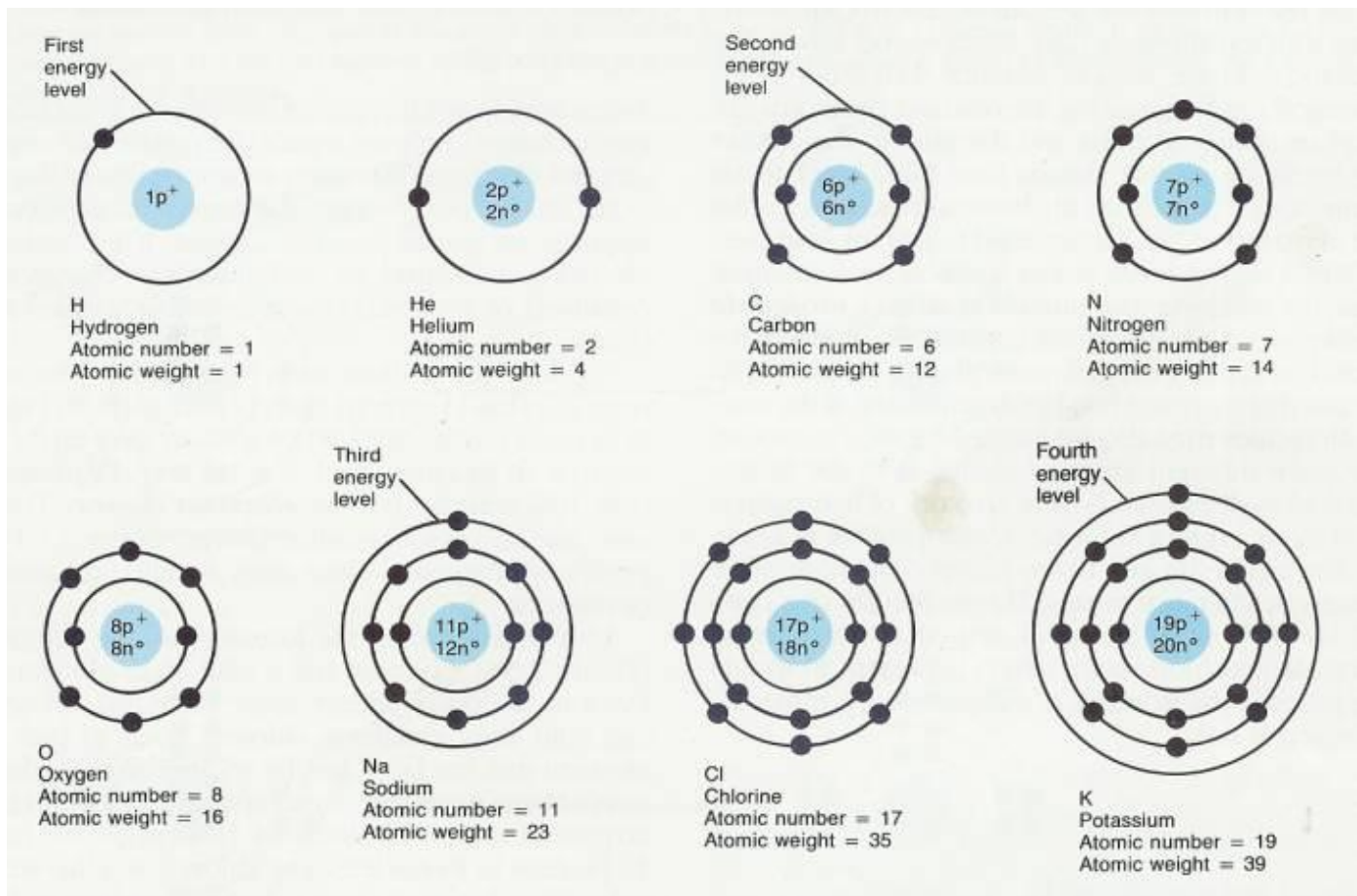
Dad's Lecture at Elizabethtown College:

ATOM:

The smallest particle of a substance that can exist by itself or be combined with other atoms to form a molecule. An atom is typically modeled as ELECTRONS circling a NUCLEUS which contains **protons** and **neutrons**.



Electrons are in shells around a nucleus, with a certain number of electrons that fit into each shell. The outer shell is called the valance shell. From: <http://www.merriam-webster.com/dictionary/atom>, <http://www.freethought-forum.com/forum/showthread.php?t=24978&gargq=2>



From: <http://www.anatomyfacts.com/muscle/anatomy.htm>

PERIODIC TABLE

A grid of every element that exists, arranged in order of atomic number, the number of protons each atom has in its nucleus. The rows are called PERIODS and all have the same number of shells; and the columns called GROUPS which all have the same number of electrons in their outermost shell. Hydrogen (H) is the first element because it has just one proton in its nucleus. Helium (He) is second, because it has two. As you go across a period, atoms get heavier, but also get smaller because the number of electron shells stays the same across the period, but the number of protons in the nucleus increases. The stronger, attractive force from the positively charged protons sucks the negatively charged electrons tighter into the center.

KEY																	
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <ul style="list-style-type: none"> Alkali metals Alkali-earth metals Transition metals Rare earths Radioactive rare earths </div> <div style="width: 45%;"> <ul style="list-style-type: none"> Other metals Semimetals Non-metals Noble gases Hydrogen </div> </div>																	
1 H Hydrogen 1																	2 He Helium 4
3 Li Lithium 7	4 Be Beryllium 9											5 B Boron 11	6 C Carbon 12	7 N Nitrogen 14	8 O Oxygen 16	9 F Fluorine 19	10 Ne Neon 20
11 Na Sodium 23	12 Mg Magnesium 24											13 Al Aluminum 27	14 Si Silicon 28	15 P Phosphorus 31	16 S Sulphur 32	17 Cl Chlorine 35	18 Ar Argon 40
19 K Potassium 39	20 Ca Calcium 40	21 Sc Scandium 45	22 Ti Titanium 48	23 V Vanadium 51	24 Cr Chromium 52	25 Mn Manganese 55	26 Fe Iron 56	27 Co Cobalt 59	28 Ni Nickel 58	29 Cu Copper 63	30 Zn Zinc 64	31 Ga Gallium 69	32 Ge Germanium 74	33 As Arsenic 75	34 Se Selenium 80	35 Br Bromine 79	36 Kr Krypton 84
37 Rb Rubidium 85	38 Sr Strontium 88	39 Y Yttrium 89	40 Zr Zirconium 90	41 Nb Niobium 93	42 Mo Molybdenum 98	43 Tc Technetium 97	44 Ru Ruthenium 102	45 Rh Rhodium 103	46 Pd Palladium 106	47 Ag Silver 107	48 Cd Cadmium 114	49 In Indium 115	50 Sn Tin 120	51 Sb Antimony 121	52 Te Tellurium 130	53 I Iodine 127	54 Xe Xenon 132
55 Cs Caesium 133	56 Ba Barium 138	57-71	72 Hf Hafnium 180	73 Ta Tantalum 181	74 W Tungsten 184	75 Re Rhenium 187	76 Os Osmium 192	77 Ir Iridium 193	78 Pt Platinum 195	79 Au Gold 197	80 Hg Mercury 202	81 Tl Thallium 205	82 Pb Lead 208	83 Bi Bismuth 209	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222
87 Fr Francium 223	88 Ra Radium 226	89-103	104 Unq Unnilquadium 260	105 Unp Unnilpentium 262	106 Unh Unnilhexium 263	107 Uns Unnilseptium 262	108 Uuo Unniloctium 265	109 Uue Unnilennium 266									
57 La Lanthanum 139	58 Ce Cerium 140	59 Pr Praseodymium 141	60 Nd Neodymium 142	61 Pm Promethium 145	62 Sm Samarium 152	63 Eu Europium 153	64 Gd Gadolinium 158	65 Tb Terbium 159	66 Dy Dysprosium 164	67 Ho Holmium 165	68 Er Erbium 168	69 Tm Thulium 169	70 Yb Ytterbium 174	71 Lu Lutetium 175			
89 Ac Actinium 227	90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium 237	94 Pu Plutonium 244	95 Am Americium 243	96 Cm Curium 247	97 Bk Berkelium 247	98 Cf Californium 251	99 Es Einsteinium 254	100 Fm Fermium 257	101 Md Mendelevium 258	102 No Nobelium 255	103 Lr Lawrencium 256			

Atomic number
is the number of protons
in the atom's nucleus

32

Ge

Germanium

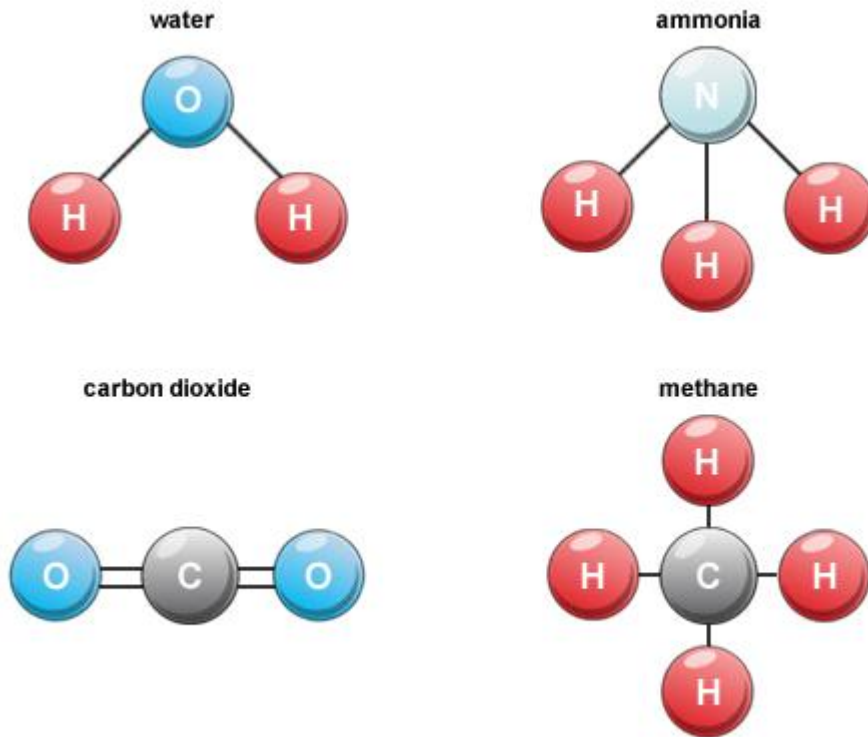
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Symbol
is used as a
short-hand
and in chemical
equations

Mass number
is the number
of protons and
neutrons in
the nucleus

MOLECULE

Smallest particle of a substance that retains all properties of the substance and is composed of one or more atoms (Typically at least two atoms bonded together).

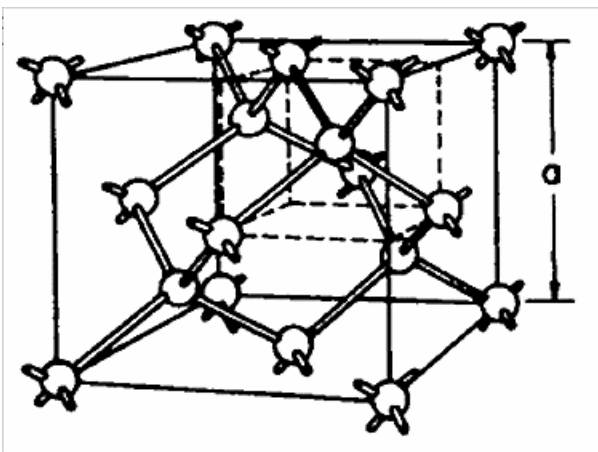


From: <http://www.merriam-webster.com/dictionary/atom>, http://www.bbc.co.uk/bitesize/standard/chemistry/images/covalent_molecules.gif

CRYSTAL LATTICE STRUCTURE

A unique arrangement of atoms or molecules in a crystalline liquid or solid. A crystal structure describes a highly ordered structure, occurring due to the intrinsic nature of molecules to form symmetrical patterns. A crystal structure can be thought of as an infinitely repeating array of 3D 'boxes', known as unit-cells.

Crystal Lattice Structure for Silicon (**Si**):



From: http://en.wikipedia.org/wiki/Crystal_structure <http://www.irf.com/technical-info/guide/semi.html>

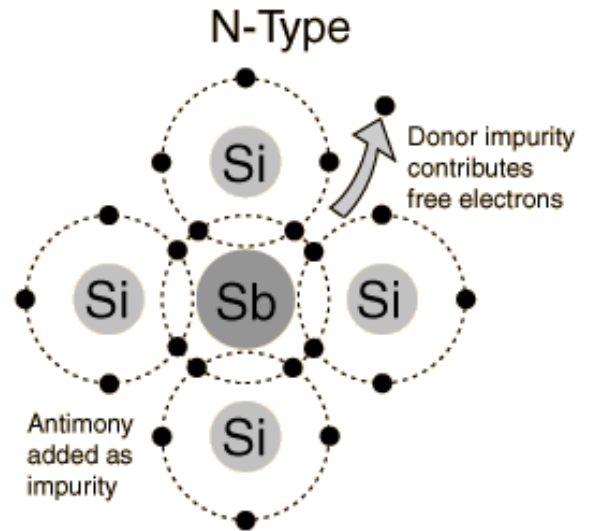
A **SEMICONDUCTOR** can be either a single element like Silicon (**Si**), or a **Molecular** compound like Gallium Arsenide, (**GaAs**). Semiconductors are not conductors of electricity like gold (**Au**) (a metal), and not an insulator which prevents electricity from flowing. Semiconductors are useful because they can be "doped" to control electrical properties and to make transistors, the basic building blocks of computers.

DOPING OF SEMICONDUCTORS

The addition of a small percentage of foreign atoms in the regular crystal lattice of silicon or germanium produces dramatic changes in their electrical properties, producing n-type and p-type semiconductors. Impurity atoms with 5 valence electrons produce n-type semiconductors by contributing extra electrons.

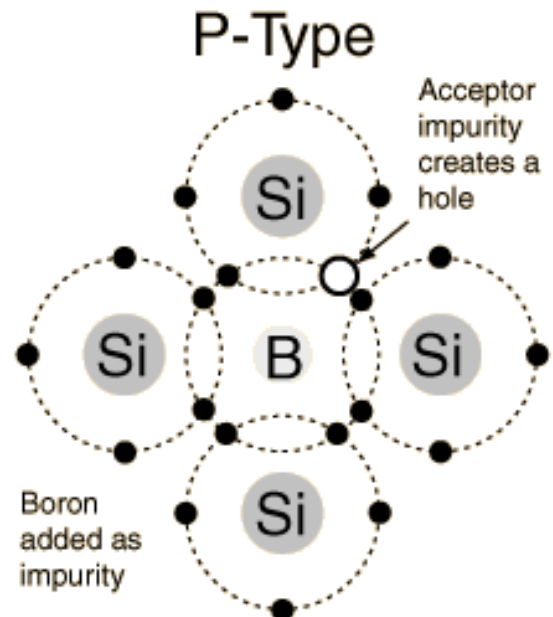
N-Type Semiconductor

The addition of atoms such as antimony (**Sb**), arsenic (**As**), or phosphorous (**P**) to a semiconductor like silicon (**Si**) contributes free electrons, greatly increasing the conductivity of the semiconductor.



P-Type Semiconductor

The addition of atoms such as boron (**B**), aluminum (**Al**) or gallium (**Ga**) to a semiconductor like silicon (**Si**) creates deficiencies of valence electrons, called "holes" – these holes attract electrons.



From: <http://hyperphysics.phy-astr.gsu.edu/hbase/solids/dope.html#c3>

Computers are made from Logic Gates which are made from Transistors which are made by - combining N and P type semiconductors to create the flow of electricity at controlled times.

Parts of another Dad lecture -- on bedroom wall:

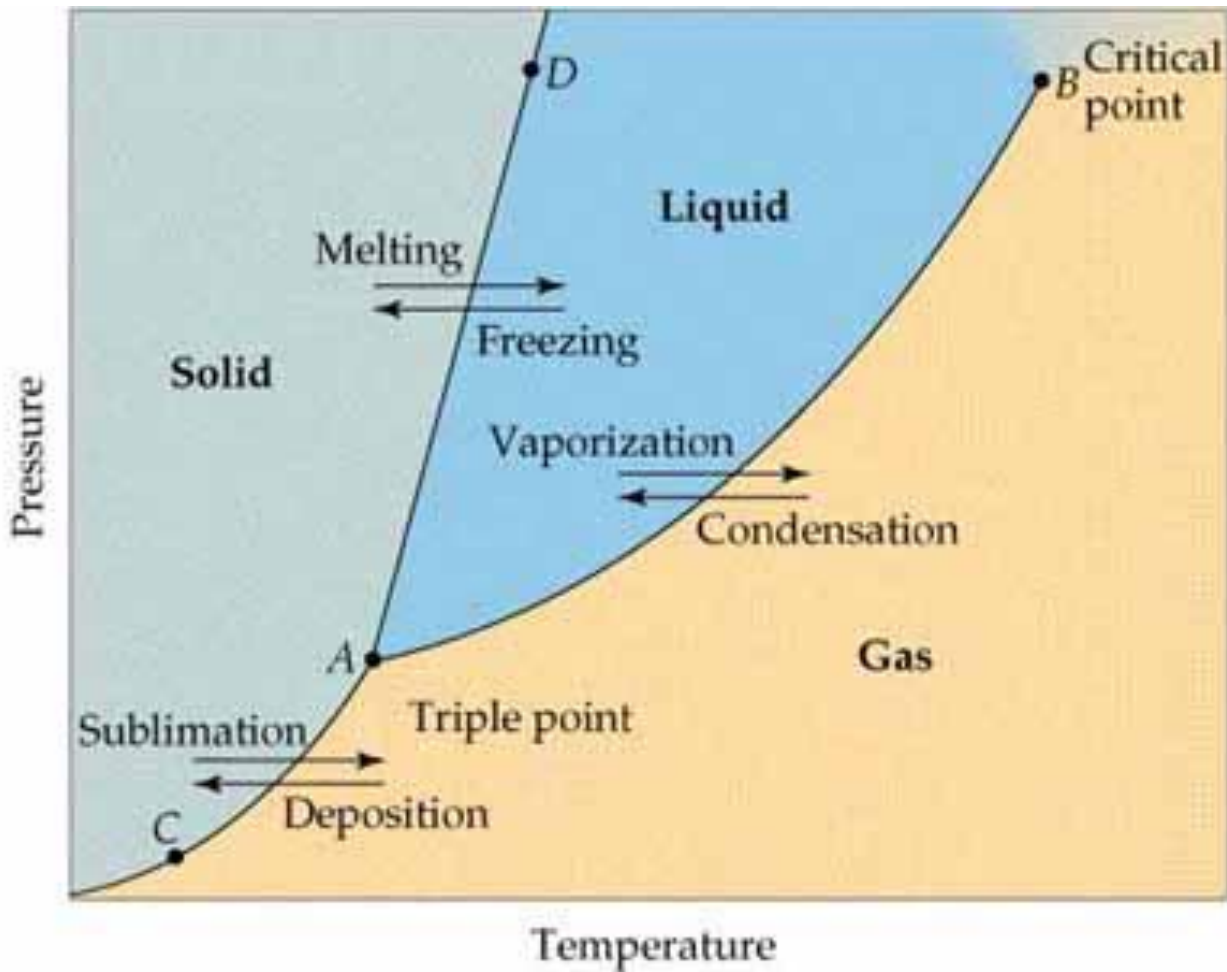
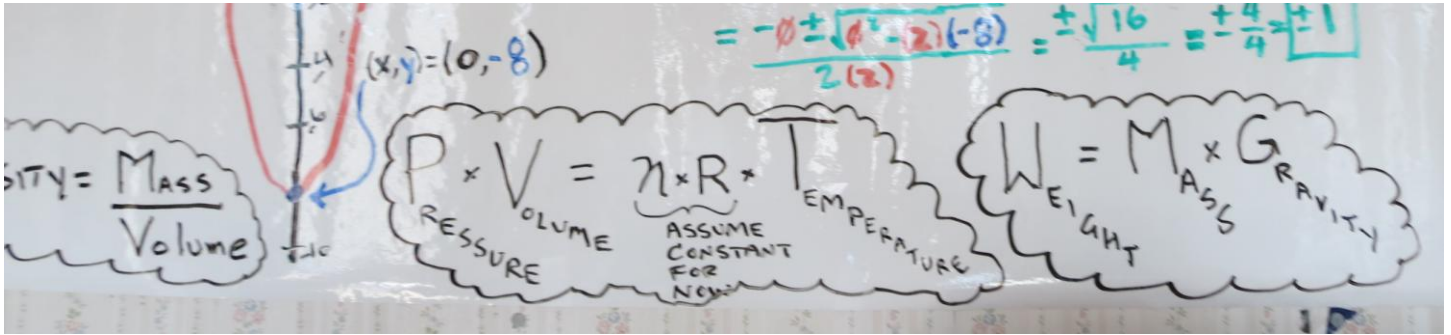


Image from: <http://wps.prenhall.com/wps/media/objects/3311/3391416/imag1106/AAUAZO0.JPG>