Chemistry 120 Fall 2016

Instructor: Dr. Upali Siriwardane

e-mail: upali@latech.edu
Office: CTH 311
Phone 257-4941

Office Hours: M,W,F 9:30-11:30 am T,R 8:00-10:00 am or by appointment;

Test Dates:

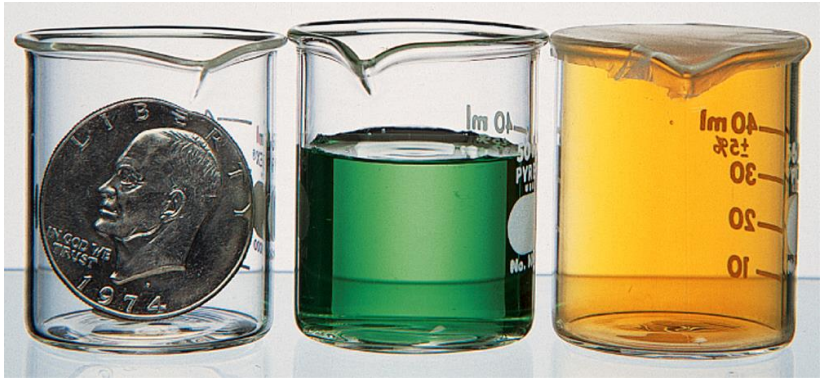
September 23, **2016 (Test 1): Chapter 1,2 &3**
October 13, **2016 (Test 2): Chapter 4 & 5**
October 31, **2016 (Test 3): Chapter 6, 7 & 8**
November 15, **2016 (Test 4): Chapter 9, 10 & 11**
November 17, **2016 (Make-up test) comprehensive: Chapters 1-11**

Chapter 1. Basic Concepts About Matter

Chemistry – the bestest thing ever!

Chemistry is the study of matter and the transformations that it undergoes.

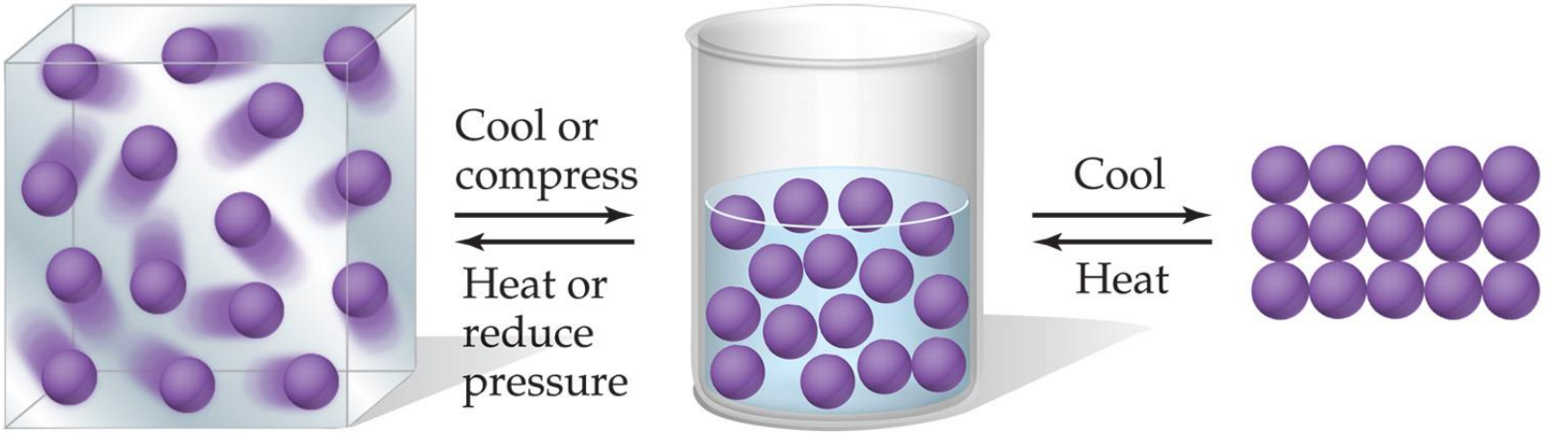
Matter



Matter is anything that has mass and takes up space.

Mass is a measure of the amount of matter in an object
Weight: a measure of the force exerted on an object by a gravitational pull

Physical states of matter



Indefinite shape
Indefinite volume

Indefinite shape
Definite volume

Definite shape
Definite volume

Chemical and physical properties of matter

- Physical Properties:

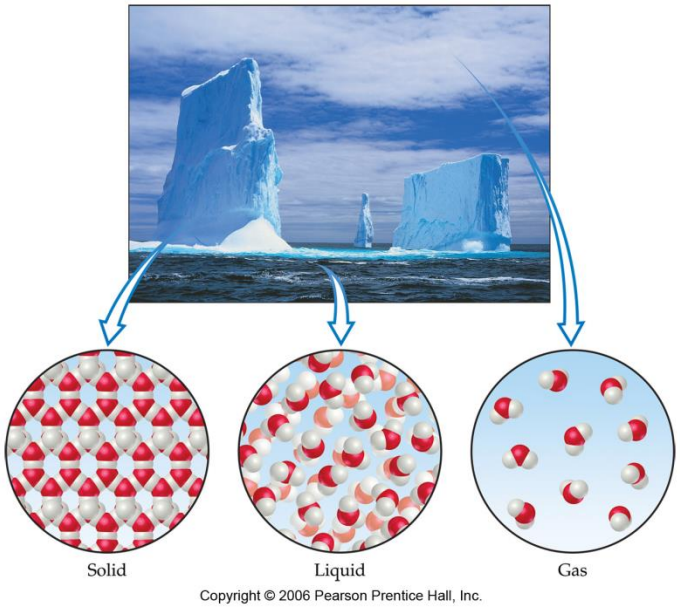
  Can be observed without transforming a substance into another substance.

  - Boiling/melting points, density, mass, volume, etc.

- Chemical Properties:

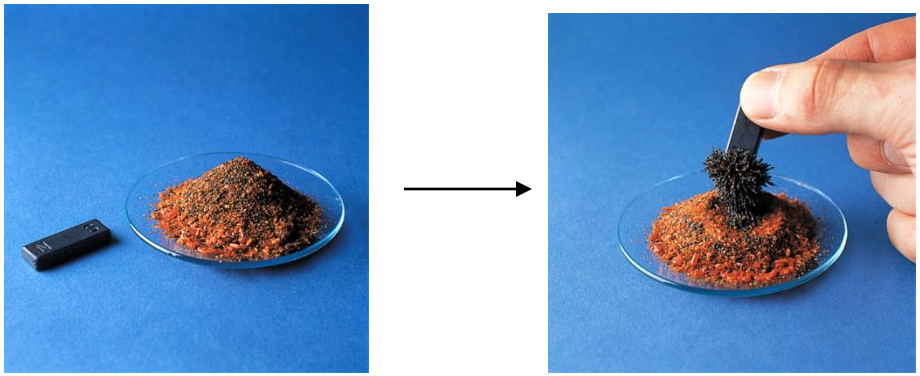
  Can *only* be observed when a substance is changed into another substance.

  - Flammability, corrosiveness, reactivity with acid, etc.



Matter: pure substances vs mixtures

- In a pure substance, only a single kind of matter can be found. The substance cannot be separated into simpler components through physical means
- Pure substances have *definite and constant compositions*
- Mixtures are combinations of two or more pure substances which can be separated into simpler components through physical means



Separation of iron filings from something non-magnetic

Something we can't drink in this classroom

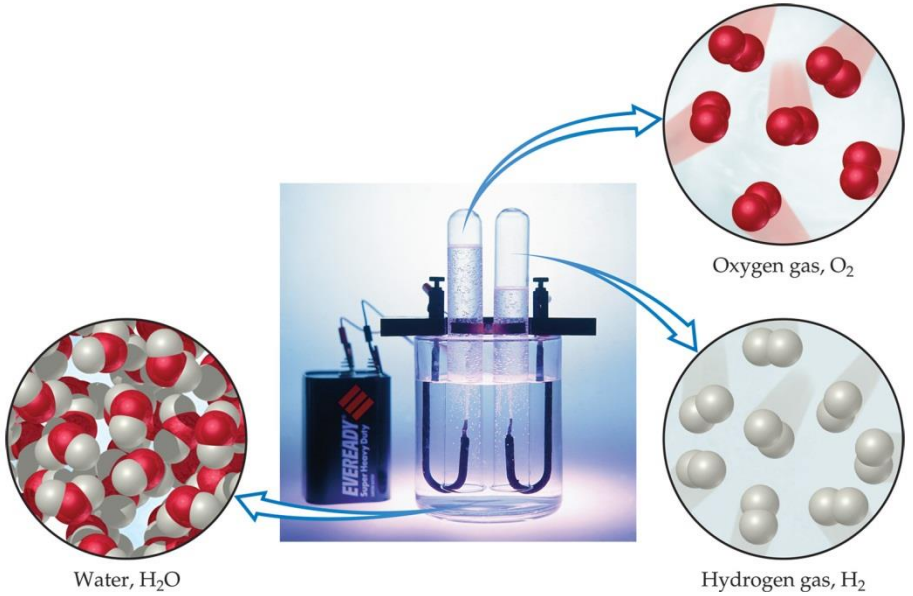
Heterogeneous and homogeneous mixtures

- Heterogeneous mixtures consist of visibly different parts, each part having its own properties

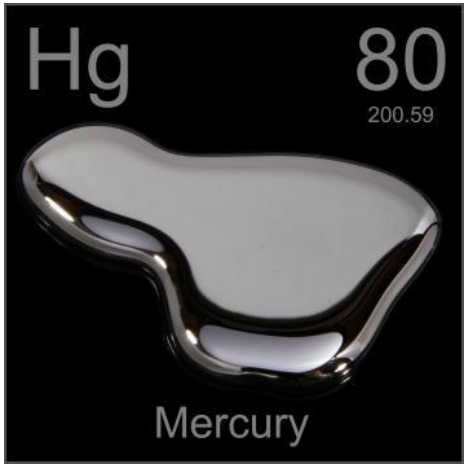
- Homogeneous mixtures appear to be of the same composition throughout, and appear to possess uniform properties

Elements and compounds

- Elements and compounds are both pure substances.
- Elements can't be broken down and isolated into simpler, pure substances by either physical or chemical means.
- Compounds may be decomposed into two or more simpler components though chemical means.

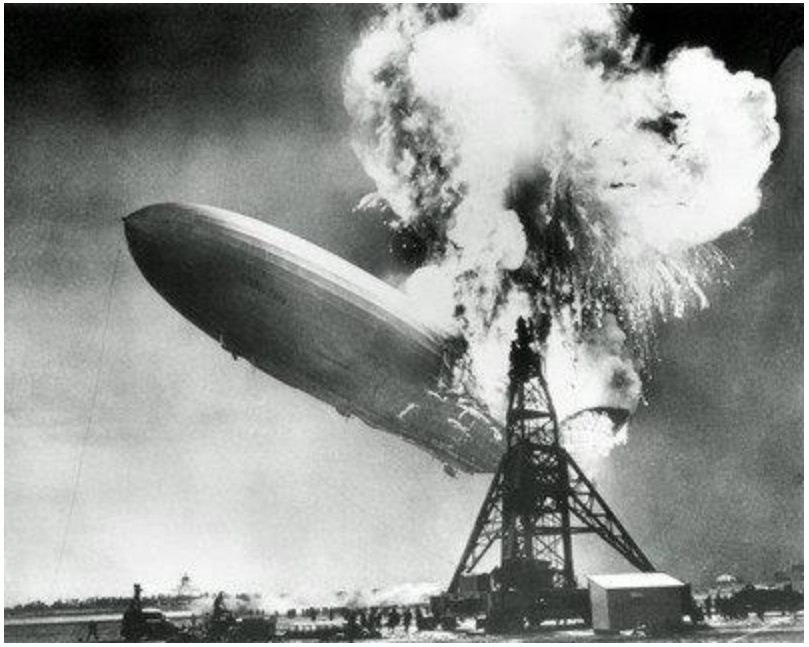


Classification of matter



Elements

- There are 117 elements known at the present time. Of these, 88 are naturally occurring.
- Elements are identified by their chemical and physical properties, and are represented by names and chemical symbols.



Hydrogen, **H**.
Found as a gas at room temperature and pressure.

Ac	actinium	Gd	gadolinium	Po	polonium
Ag	silver*	Ge	germanium	Pr	praseodymium
Al	aluminum	H	hydrogen	Pt	platinum
Am	americium	He	helium	Pu	plutonium
Ar	argon	Hf	hafnium	Ra	radium
As	arsenic	Hg	mercury*	Rb	rubidium
At	astatine	Ho	holmium	Re	rhenium
Au	gold*	Hs	hassium	Rf	rutherfordium
B	boron	I	iodine	Rg	roentgenium
Ba	barium	In	indium	Rh	rhodium
Be	beryllium	Ir	iridium	Rn	radon
Bh	bohrium	K	potassium*	Ru	ruthenium
Bi	bismuth	Kr	krypton	S	sulfur
Bk	berkelium	La	lanthanum	Sb	antimony*
Br	bromine	Li	lithium	Sc	scandium
C	carbon	Lr	lawrencium	Se	selenium
Ca	calcium	Lu	lutetium	Sg	seaborgium
Cd	cadmium	Md	mendelevium	Si	silicon
Ce	cerium	Mg	magnesium	Sm	samarium
Cf	californium	Mn	manganese	Sn	tin*
Cl	chlorine	Mo	molybdenum	Sr	strontium
Cm	curium	Mt	meitnerium	Ta	tantalum
Co	cobalt	N	nitrogen	Tb	terbium
Cr	chromium	Na	sodium*	Tc	technetium
Cs	cesium	Nb	niobium	Te	tellurium
Cu	copper*	Nd	neodymium	Th	thorium
Db	dubnium	Ne	neon	Ti	titanium
Ds	darmstadtium	Ni	nickel	Tl	thallium
Dy	dysprosium	No	nobelium	Tm	thulium
Er	erbium	Np	neptunium	U	uranium
Es	einsteinium	O	oxygen	V	vanadium
Eu	europium	Os	osmium	W	tungsten*
F	fluorine	P	phosphorus	Xe	xenon
Fe	iron*	Pa	protactinium	Y	yttrium
Fm	fermium	Pb	lead*	Yb	ytterbium
Fr	francium	Pd	palladium	Zn	zinc
Ga	gallium	Pm	promethium	Zr	zirconium

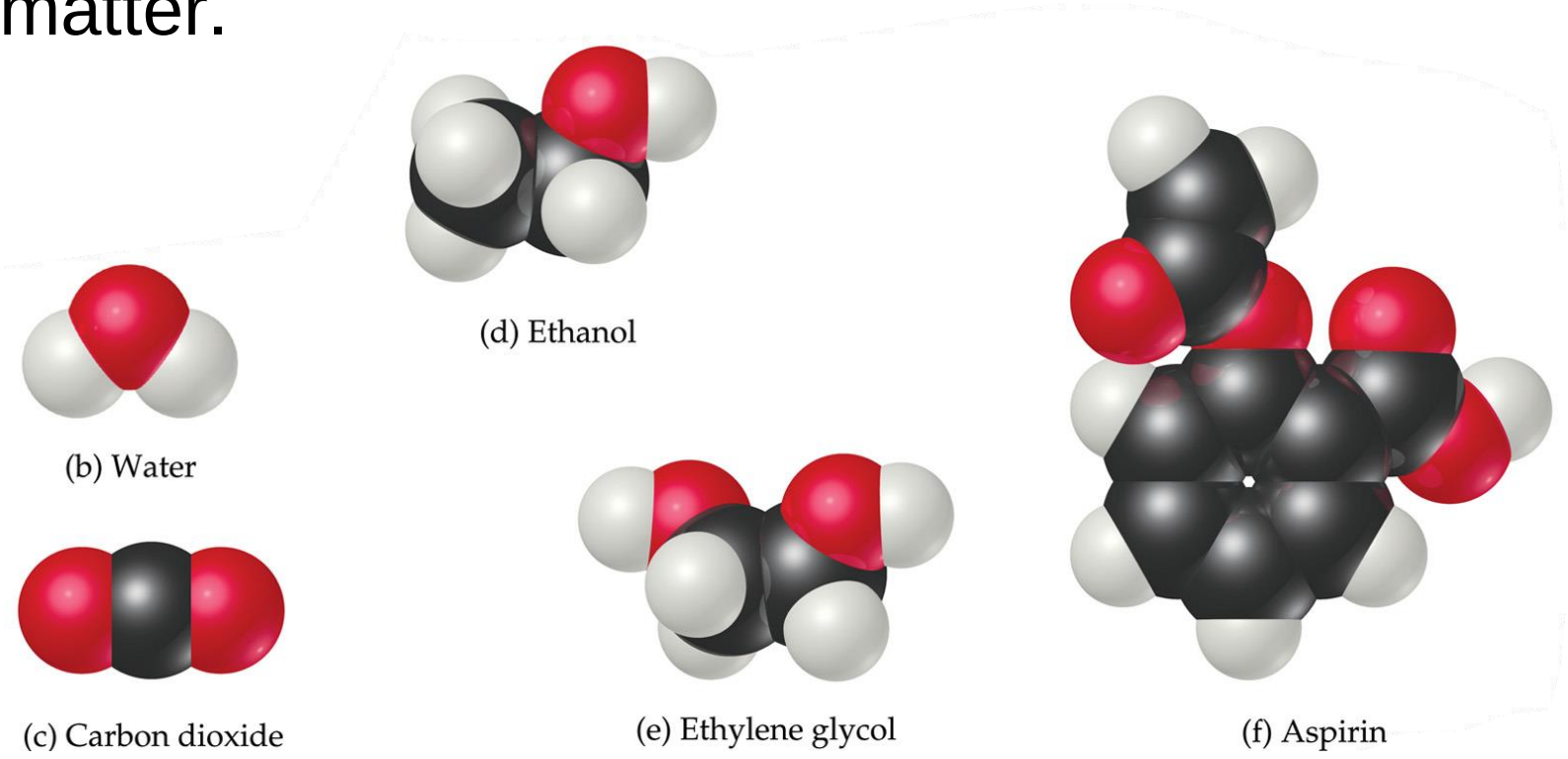
Only 111 elements are listed in this table. Elements 112–115 discovered (synthesized) in the period 1996–2004 are yet to be named.

*These elements have symbols that were derived from non-English names.

- Know the names and symbols for the elements listed in red

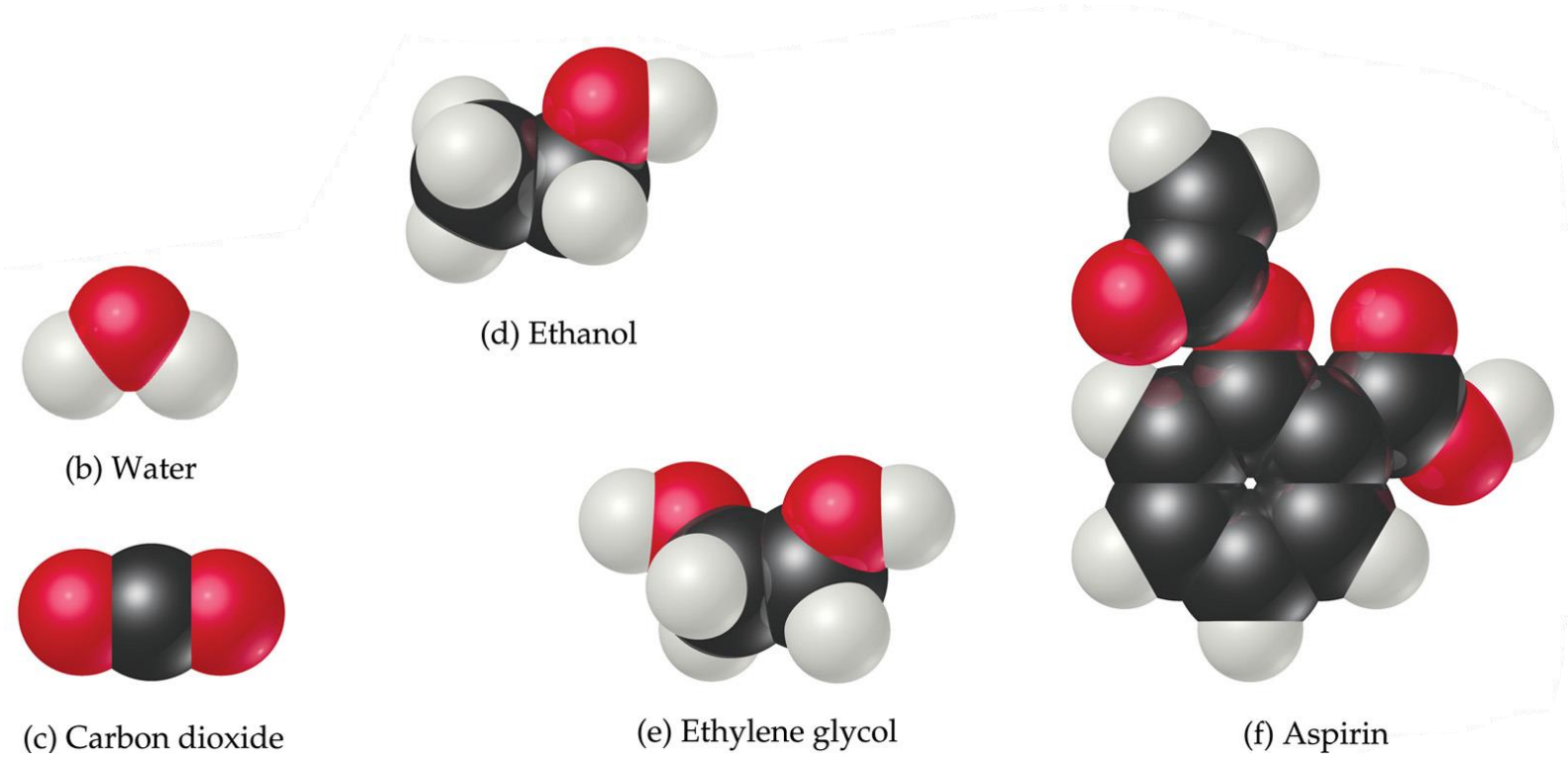
Atoms, elements and compounds

- The simplest unit of an element which possesses all of the properties of the element is an atom. Atoms are the basic building blocks of matter.



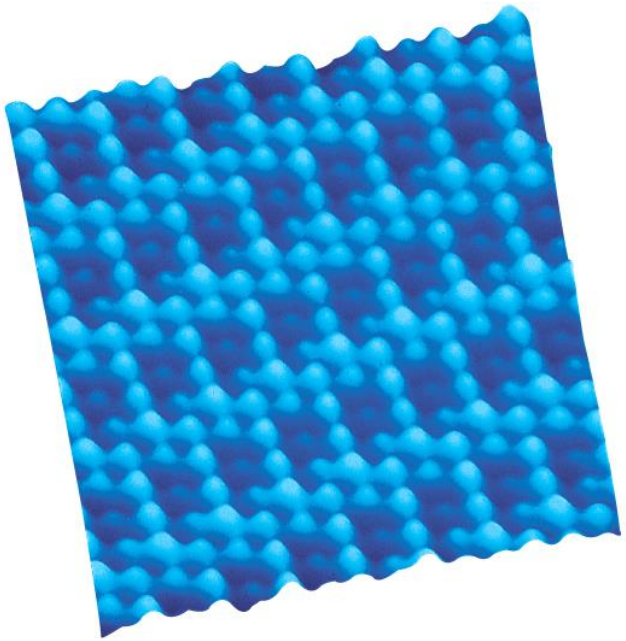
Matter

A compound is made of two or more different kinds of elements.

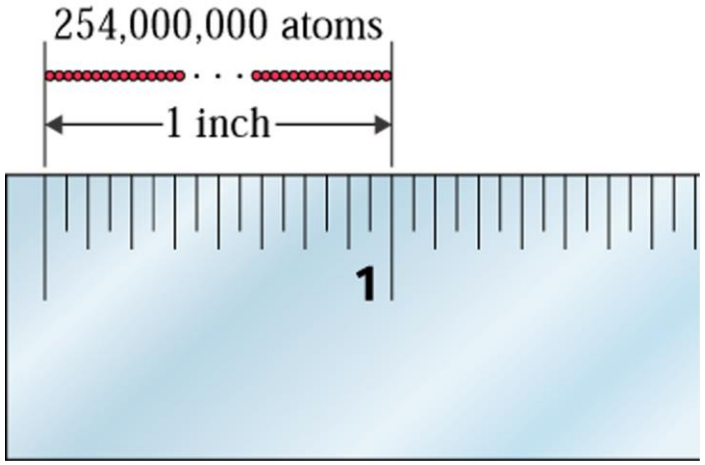


Atoms

- Atoms have extremely small dimensions. They cannot be seen with the naked eye, but sophisticated (and very expensive) techniques may enable resolution of atoms



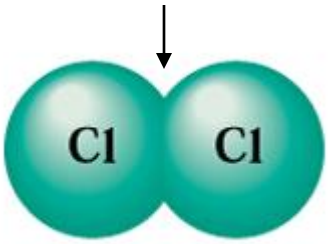
STM image of a crystal surface



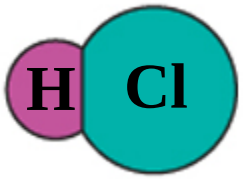
Molecules

- Atoms can combine to form larger structures called molecules. A molecule is a combination of two or more atoms to create a new unit which possesses properties that are different from the atoms that make it up.
- Molecules that consist of two atoms are called diatomic. Molecules that consist of three atoms are called triatomic, etc.
- If only one type of atom exists in a molecule, it is called homonuclear or homoatomic. If two or more, different types of atoms exist in a molecule, it is called heteronuclear or heteroatomic.

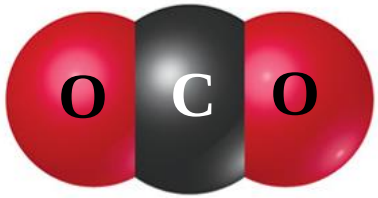
In an element, there is only one type of atom



Cl_2



HCl



CO_2

Chemical formulas

- Chemical formulas represent the number and type of atoms of each element in a molecule
- Chemical symbols represent the type of each element (e.g. C, H, O, N, etc.)
- Subscripts to the lower right of a chemical symbol represent the number of atoms of that element