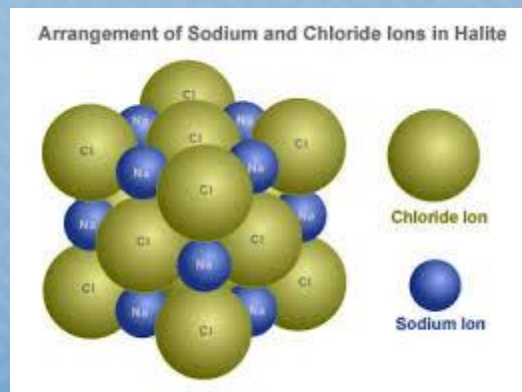


Chapter 1

Matter and Change

What is Chemistry?

Chemistry is the study of the composition, structure, and properties of matter and the changes it undergoes.



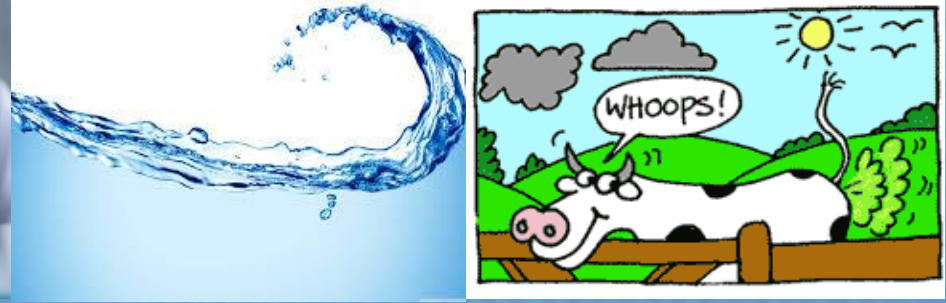
What is a chemical?

Chapter 1

A chemical is a substance produced by or used in a chemical process.

How does chemistry affect our everyday life?

How many of our activities involve chemistry?

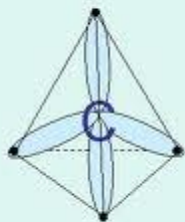


Branches of Chemistry

Organic Chemistry - the study of most carbon containing compounds.

Inorganic Chemistry - the study of all substances not classified organic, mainly those compounds that do not contain carbon.

Organic Chemistry



The Chemistry of Carbon



Physical Chemistry - the study of the properties and changes of matter and their relation to energy.

Analytical Chemistry - the identification of the components and composition of materials.

Biochemistry - the study of the substances and processes occurring in living things.



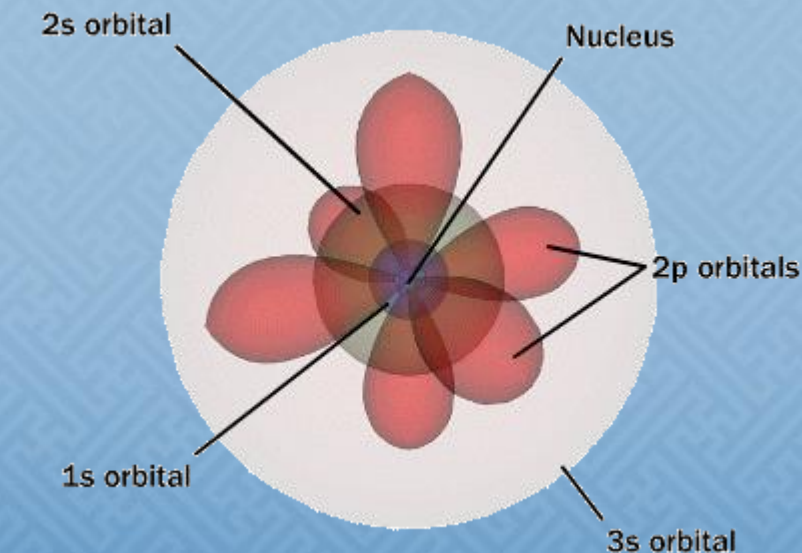
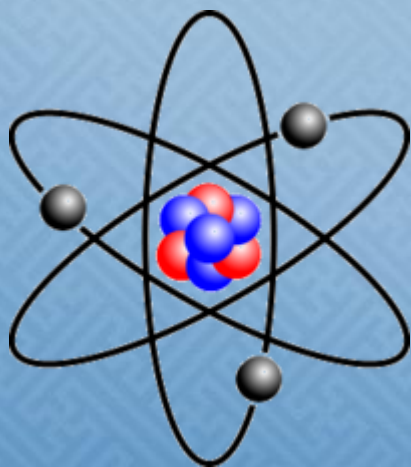


Matter and Its Properties

Basic building blocks of matter:

atom - the smallest unit of an element that maintains the properties of that element.

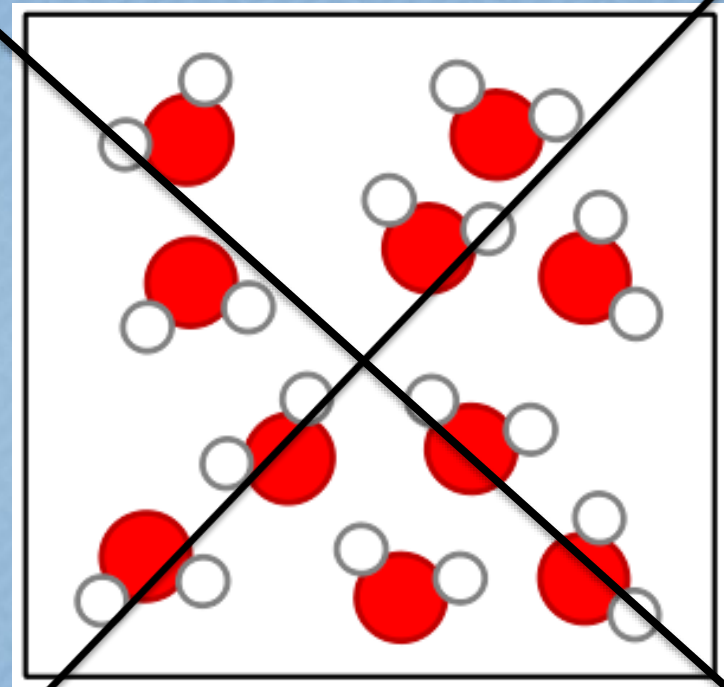
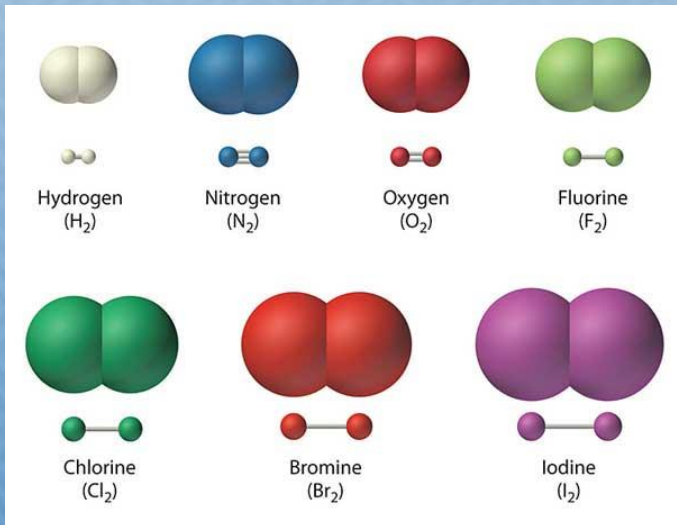
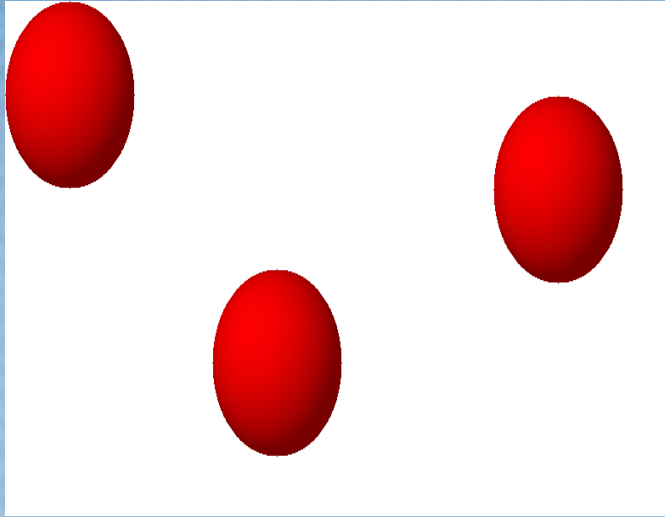
element - a pure substance made of only one kind of atom.



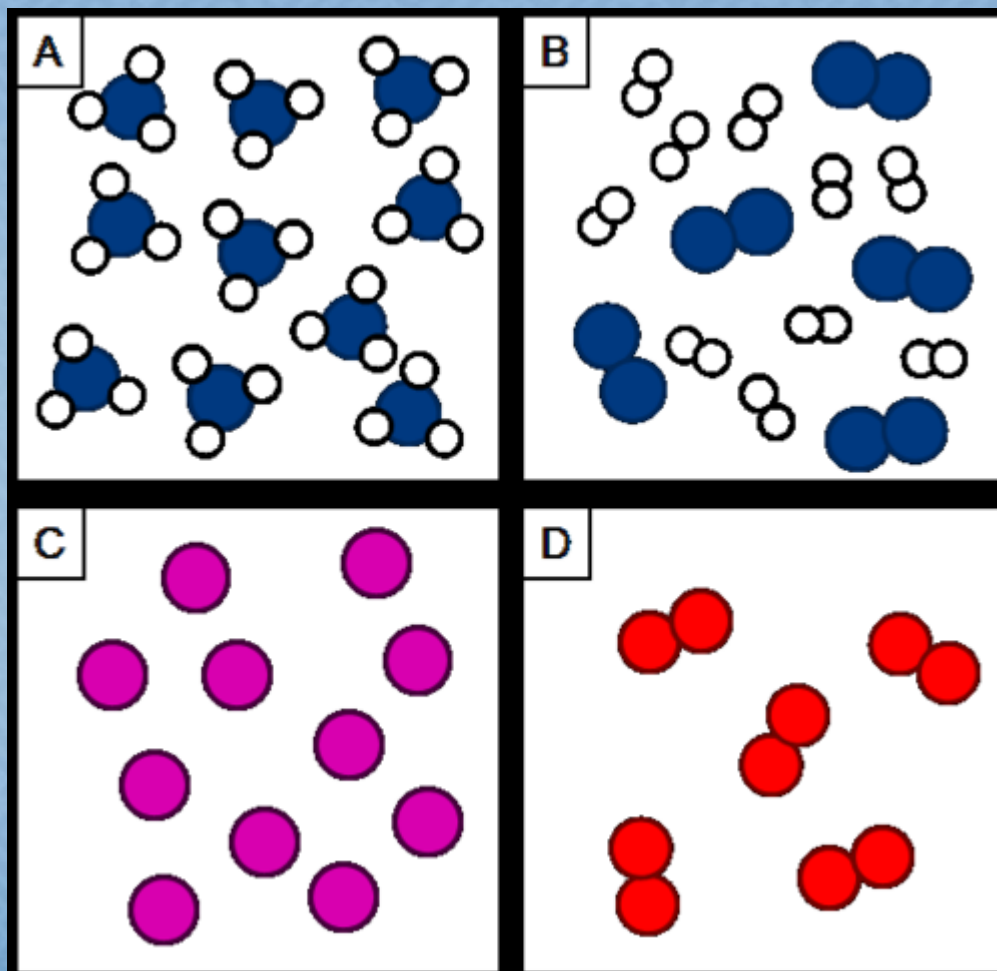
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Particle Visualization of an Element:



Which one of these is an element?



Formula Representation of an Element:

H

S₈

Fe

Br₂

H₂O

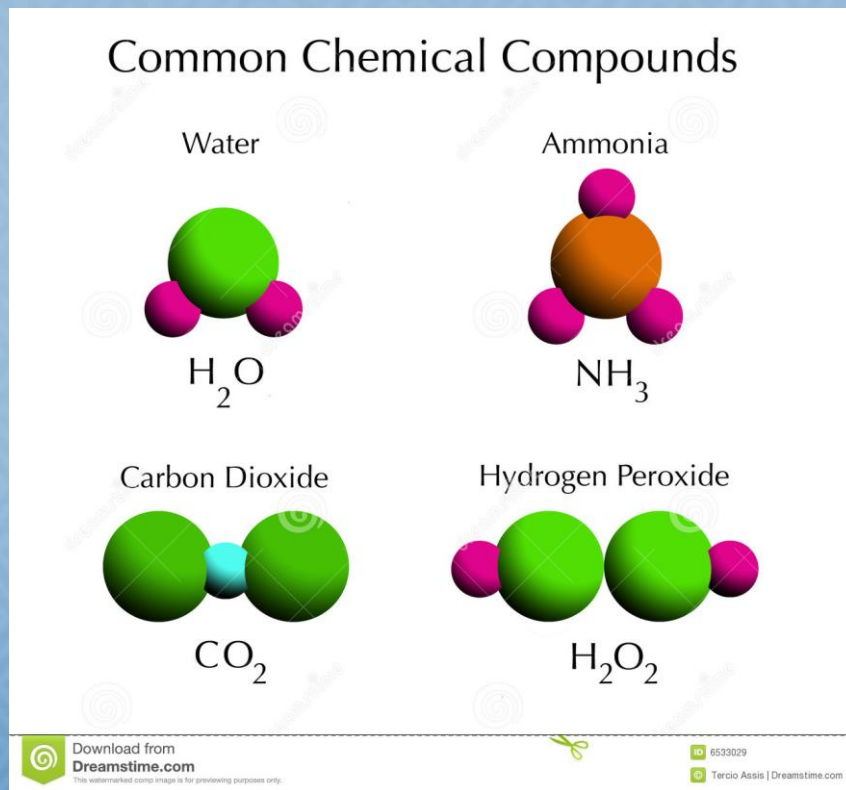
SO₄

MgCl₂

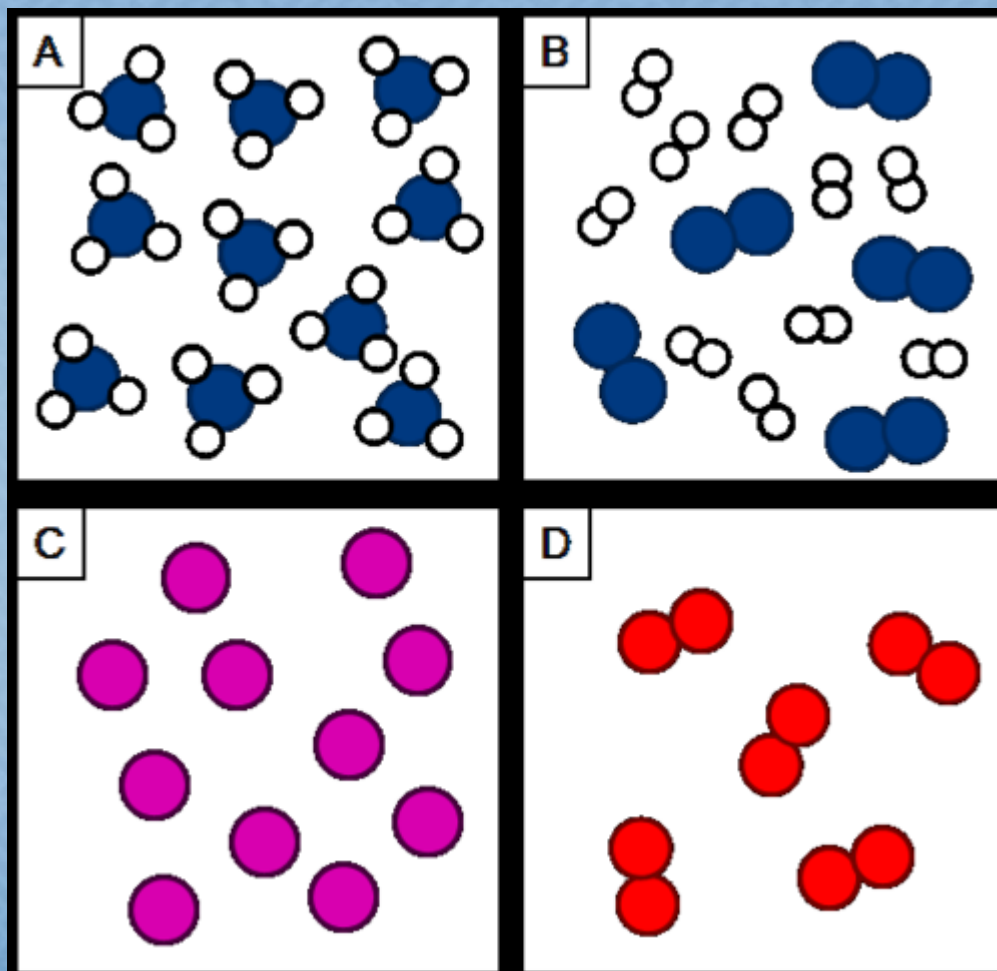
NaBr

Chapter 1

compound - a substance that is made from the atoms of two or more elements that are chemically bonded.



Which one of these is a compound?

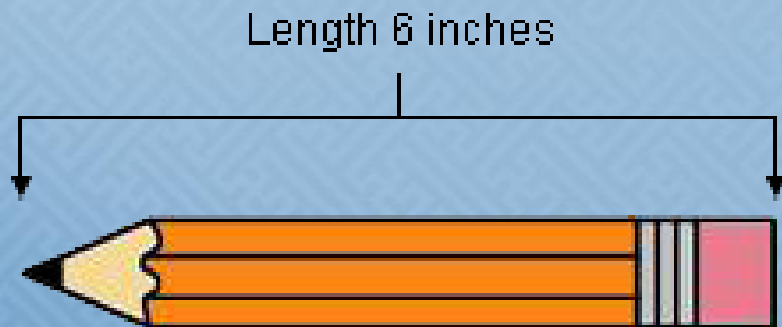


Chapter 1

Properties and changes in matter:

Extrinsic properties - depend on the amount of matter that is present.

Examples : volume, mass, amount of energy in a substance



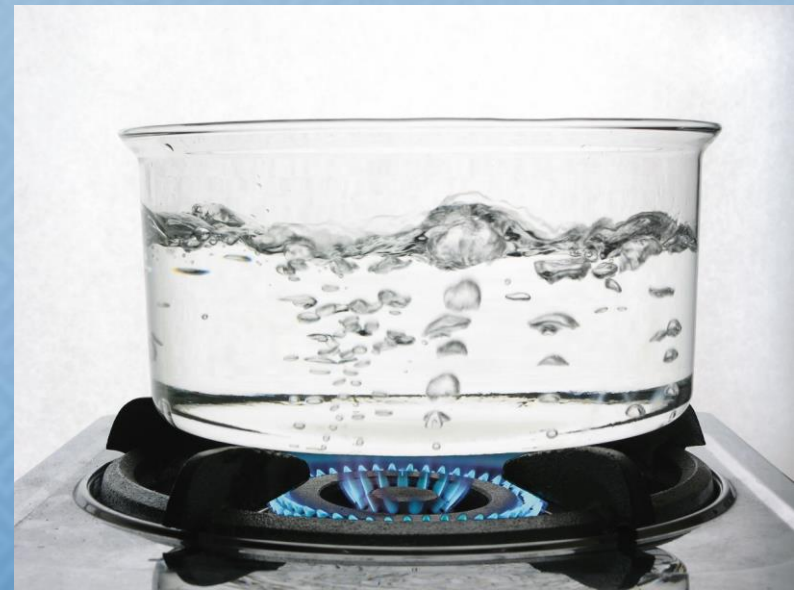
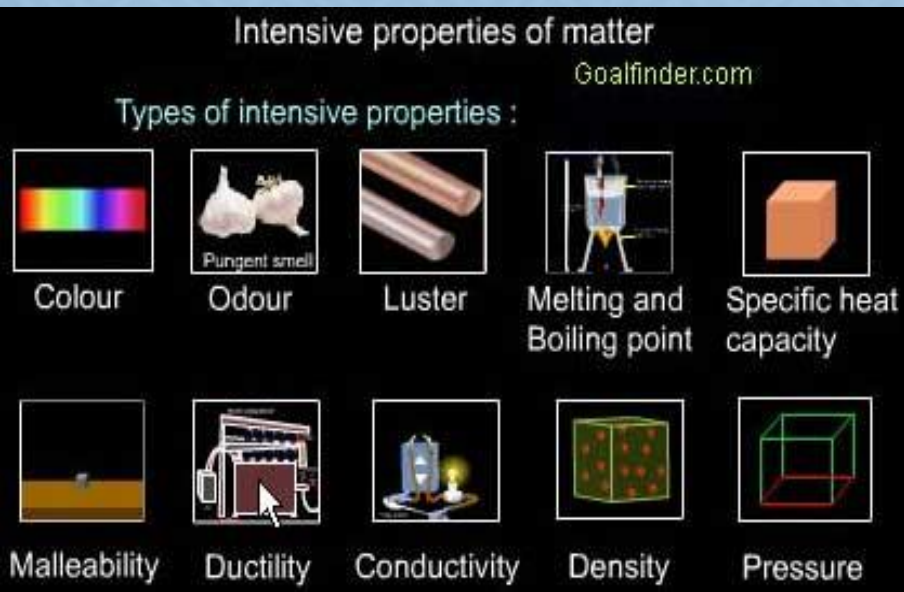
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Chapter 1

Intrinsic properties - do not depend on the amount of matter present.

Examples : melting point, boiling point, density, ability to conduct heat and electricity.



Physical property - a characteristic that can be observed without changing the identity of the substance.

Physical change - a change in the substance that **does not** involve a change in the identity of the substance.

A change of state is a physical change from one state to another.

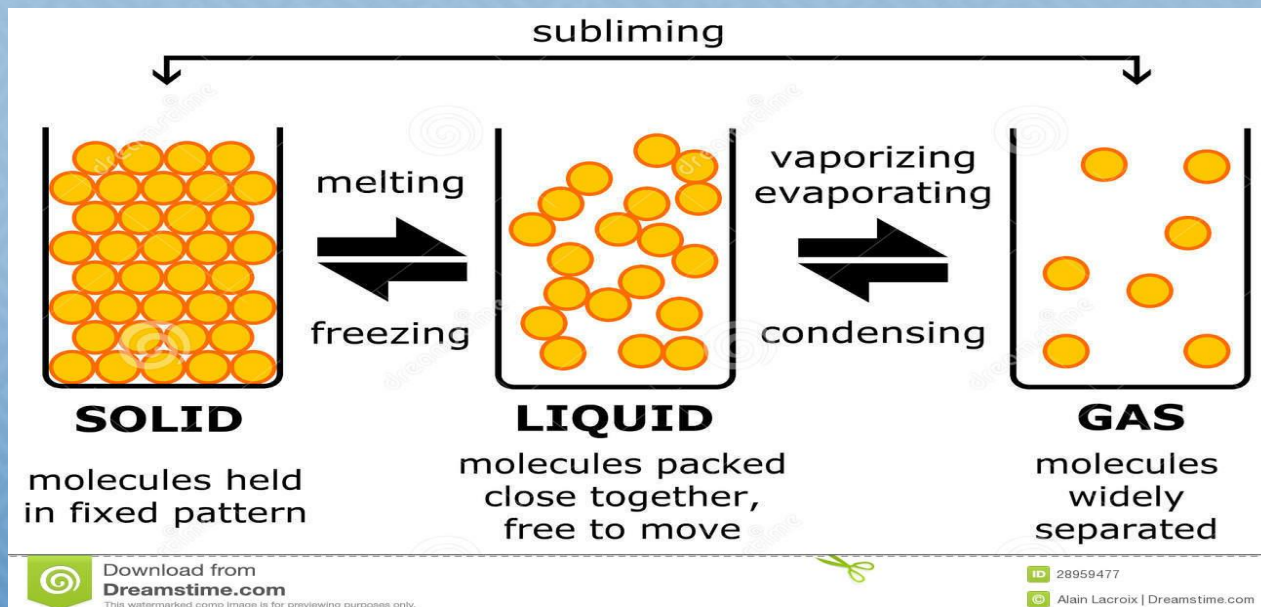


Solid - definite volume and definite shape

Liquid - definite volume but indefinite shape

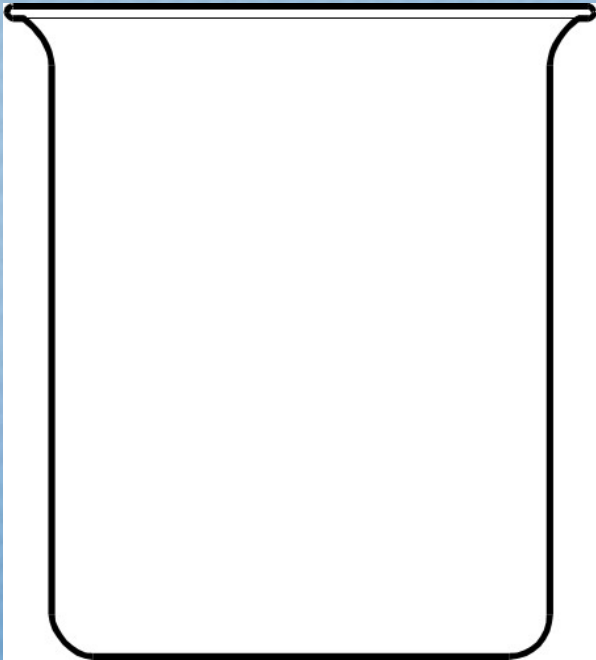
Gas - indefinite volume and indefinite shape

Plasma - high temperature physical state in which atoms lose their electrons

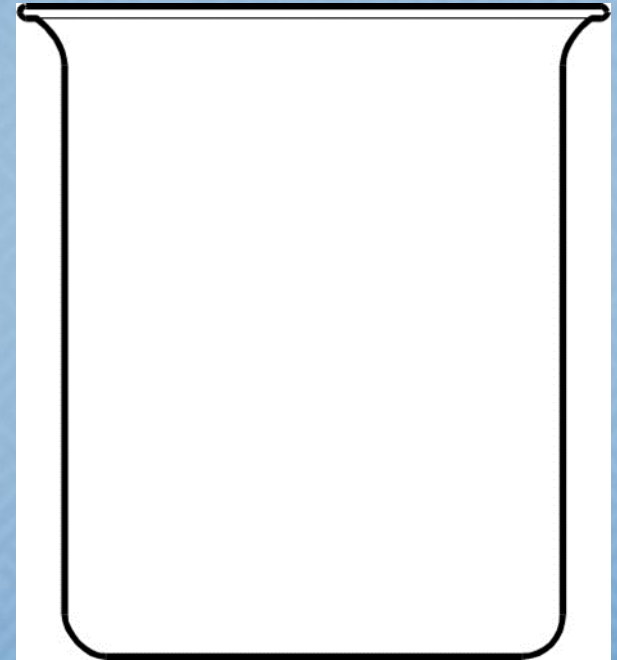


Particle Drawing of a Physical Change:

Water Before Boiling:



Water After Boiling:



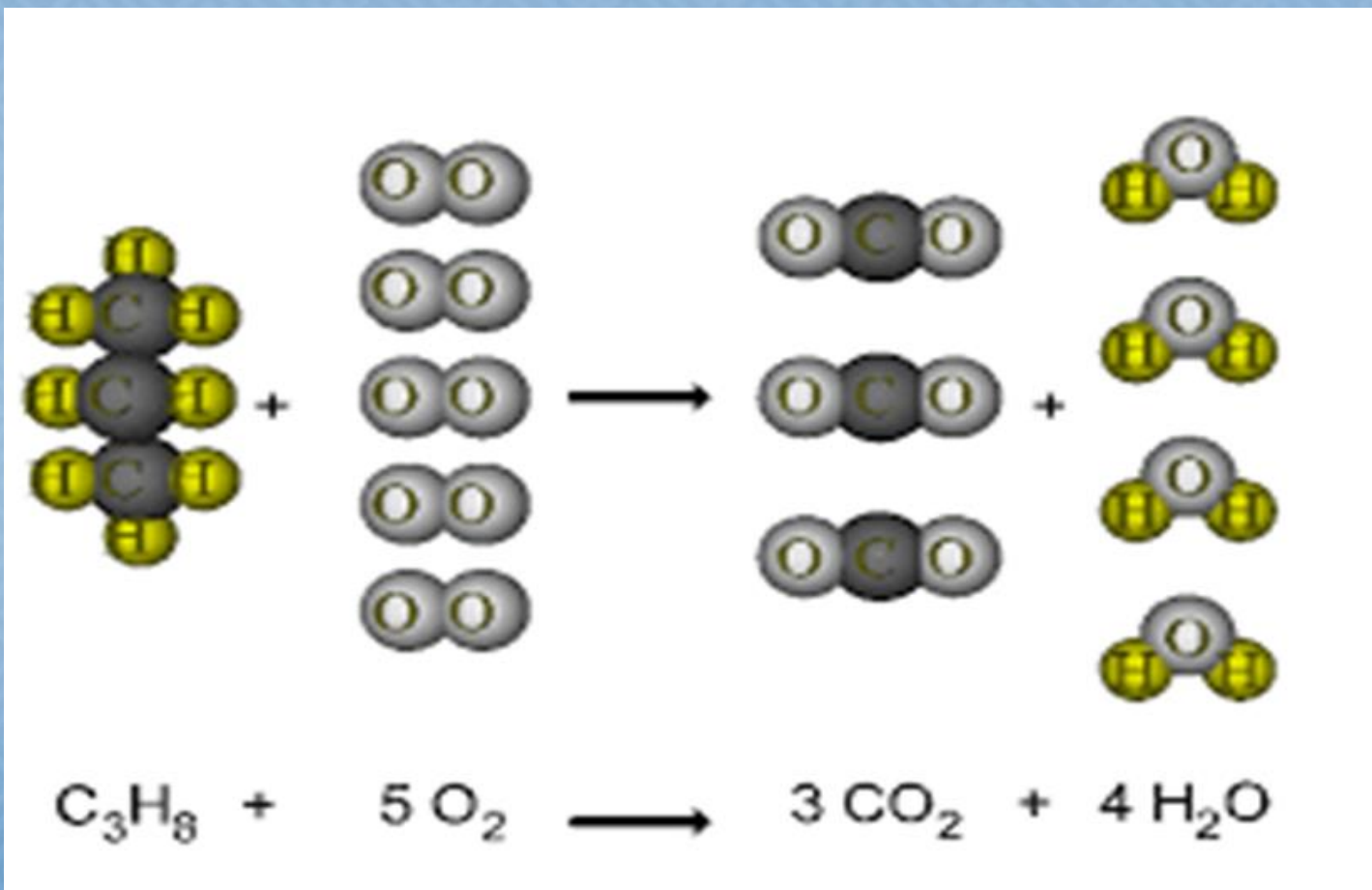
Chemical properties and chemical changes:

Chemical property - a substance's ability to undergo changes that transforms it into different substances.

Chemical change or chemical reaction - a change in which one or more substances are converted into different substances.



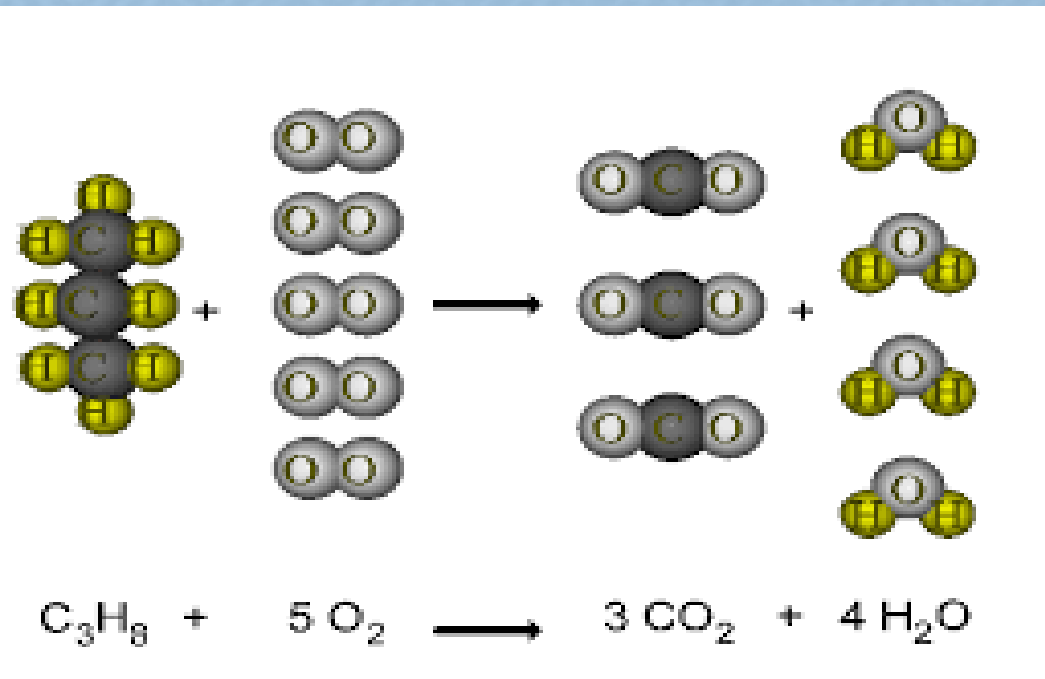
Particle Drawing of a Chemical Change:



Reactants - substances that react in a chemical change.

Products - substances that are formed by the chemical change.

Reactants → Products



Chemical changes do not affect the amount of matter present.

Chemical and physical changes are always accompanied by energy changes.

Energy may be released or absorbed.

Exothermic - a process that releases heat

Endothermic - a process that absorbs heat



Indications of a chemical reaction:

1.) Evolution of heat and light.

(Heat alone may not be a chemical reaction.)

2.) Change in color

3.) Production of a gas.

4.) Formation of a precipitate.

(A solid that separates from a solution.)



Change in color
Bleaching hair changes its color.



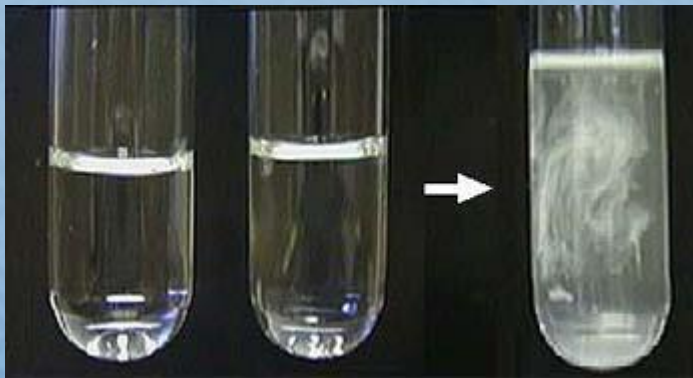
Change in temperature
Burning wood produces heat.



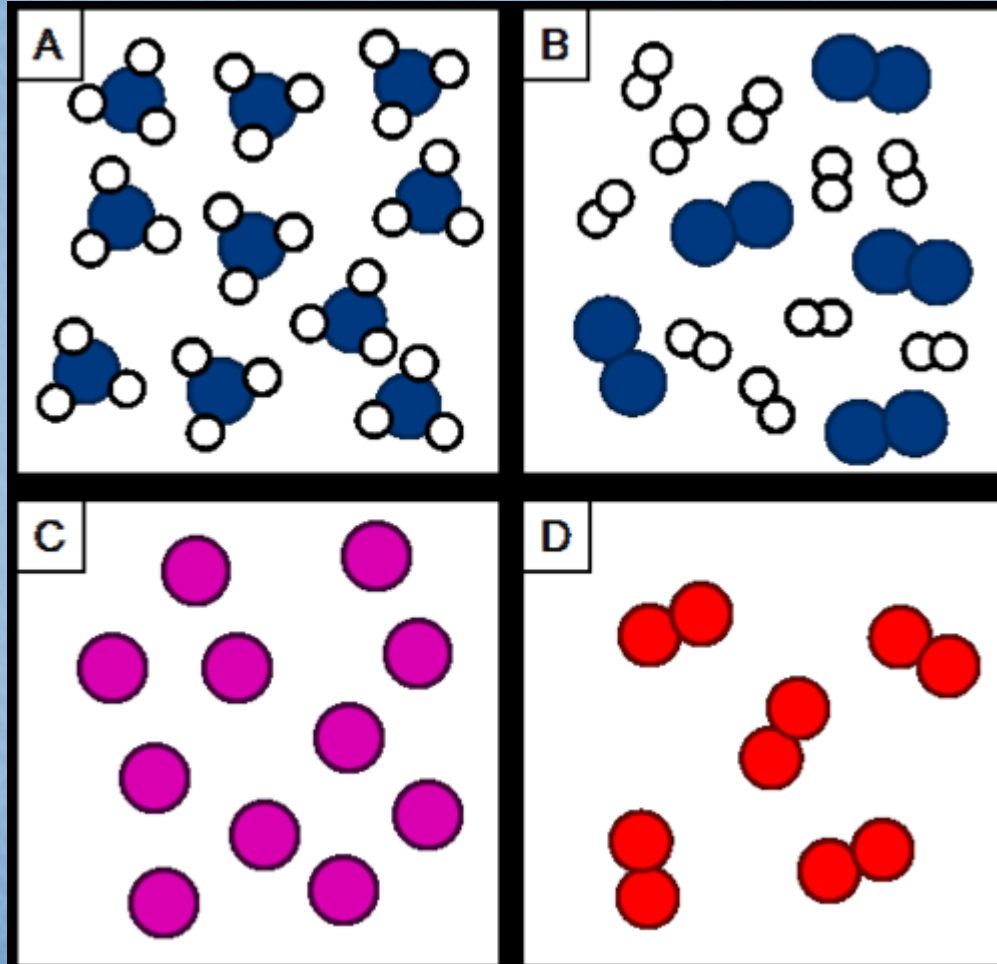
Production of a gas
Dissolving an antacid tablet in water produces gas bubbles.



Production of a solid
Adding acid to milk produces solid curds of cottage cheese



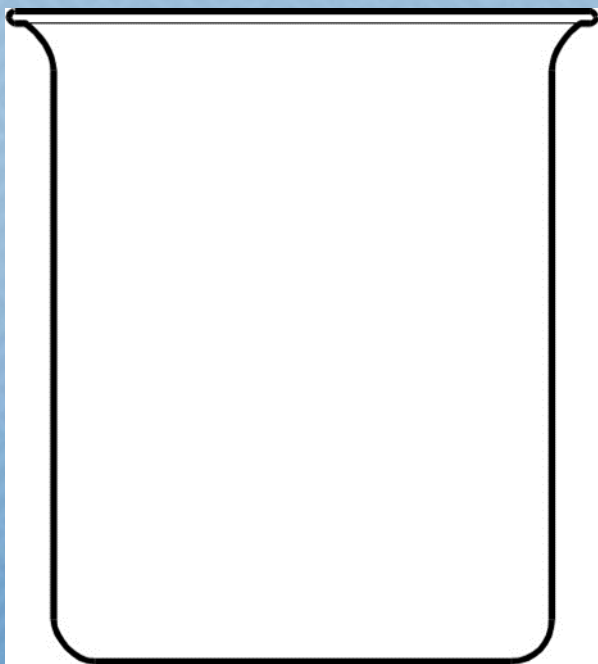
Wait, what the heck is B?



How would you write/draw a mixture:

Salt Water

Particle Drawing of
a mixture:



Formula of a
mixture:

Classification of Matter

mixture - a blend of two or more kinds of matter, each of which retains its own identity and properties.

Homogeneous - uniform in composition

Homogeneous mixtures are also known as solutions.

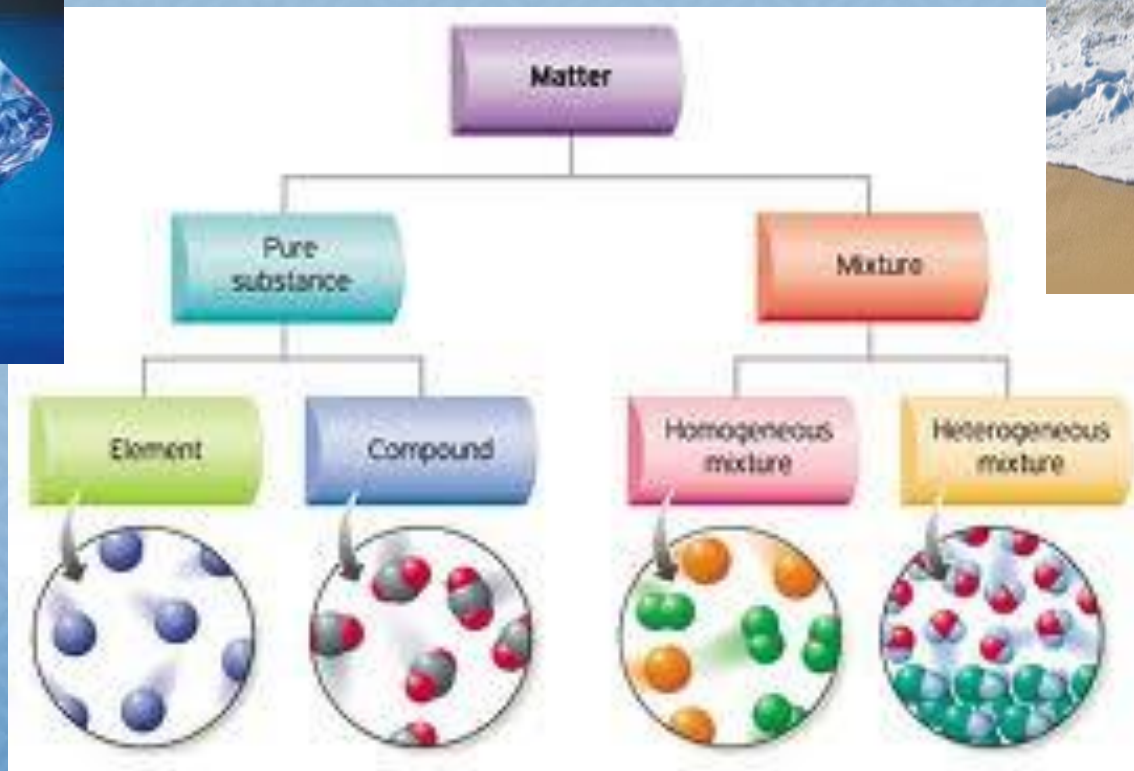
Heterogeneous - not uniform throughout.



Pure substance - Has a fixed composition

1. Every sample of a given pure substance has exactly the same characteristic properties.

2. Every sample of a given pure substance has exactly the same composition.



The Periodic Table

groups or families - vertical columns
periods - horizontal rows

Periodic Table of Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																			
1	<div><div>1</div><div>H</div><div>Hydrogen</div><div>1.00794</div></div>	<div><div>Atomic #</div><div>Symbol</div><div>Name</div><div>Atomic Mass</div></div> <div><div>C</div>Solid</div> <div><div>Hg</div>Liquid</div> <div><div>H</div>Gas</div> <div><div>Rf</div>Unknown</div> <div><div>Alkali metals</div><div>Alkaline earth metals</div><div><div>Metals</div><div>Lanthanoids</div><div>Actinoids</div></div><div>Transition metals</div><div>Poor metals</div><div>Other nonmetals</div><div>Noble gases</div></div>																2	<div><div>2</div><div>He</div><div>Helium</div><div>4.002602</div></div>																		
3	<div><div>3</div><div>Li</div><div>Lithium</div><div>6.941</div></div>	4	<div><div>4</div><div>Be</div><div>Beryllium</div><div>9.012182</div></div>													5	<div><div>5</div><div>B</div><div>Boron</div><div>10.811</div></div>	6	<div><div>6</div><div>C</div><div>Carbon</div><div>12.0107</div></div>	7	<div><div>7</div><div>N</div><div>Nitrogen</div><div>14.0067</div></div>	8	<div><div>8</div><div>O</div><div>Oxygen</div><div>15.9994</div></div>	9	<div><div>9</div><div>F</div><div>Fluorine</div><div>18.9984032</div></div>	10	<div><div>10</div><div>Ne</div><div>Neon</div><div>20.1797</div></div>										
11	<div><div>11</div><div>Na</div><div>Sodium</div><div>22.98976928</div></div>	12	<div><div>12</div><div>Mg</div><div>Magnesium</div><div>24.3050</div></div>													13	<div><div>13</div><div>Al</div><div>Aluminium</div><div>26.9815386</div></div>	14	<div><div>14</div><div>Si</div><div>Silicon</div><div>28.0855</div></div>	15	<div><div>15</div><div>P</div><div>Phosphorus</div><div>30.973762</div></div>	16	<div><div>16</div><div>S</div><div>Sulfur</div><div>32.065</div></div>	17	<div><div>17</div><div>Cl</div><div>Chlorine</div><div>35.453</div></div>	18	<div><div>18</div><div>Ar</div><div>Argon</div><div>39.948</div></div>										
19	<div><div>19</div><div>K</div><div>Potassium</div><div>39.0983</div></div>	20	<div><div>20</div><div>Ca</div><div>Calcium</div><div>40.078</div></div>	21	<div><div>21</div><div>Sc</div><div>Scandium</div><div>44.955912</div></div>	22	<div><div>22</div><div>Ti</div><div>Titanium</div><div>47.887</div></div>	23	<div><div>23</div><div>V</div><div>Vanadium</div><div>50.9415</div></div>	24	<div><div>24</div><div>Cr</div><div>Chromium</div><div>51.9961</div></div>	25	<div><div>25</div><div>Mn</div><div>Manganese</div><div>54.938045</div></div>	26	<div><div>26</div><div>Fe</div><div>Iron</div><div>55.845</div></div>	27	<div><div>27</div><div>Co</div><div>Cobalt</div><div>58.933195</div></div>	28	<div><div>28</div><div>Ni</div><div>Nickel</div><div>58.6934</div></div>	29	<div><div>29</div><div>Cu</div><div>Copper</div><div>63.546</div></div>	30	<div><div>30</div><div>Zn</div><div>Zinc</div><div>65.38</div></div>	31	<div><div>31</div><div>Ga</div><div>Gallium</div><div>69.723</div></div>	32	<div><div>32</div><div>Ge</div><div>Germanium</div><div>72.64</div></div>	33	<div><div>33</div><div>As</div><div>Arsenic</div><div>74.92160</div></div>	34	<div><div>34</div><div>Se</div><div>Selenium</div><div>78.96</div></div>	35	<div><div>35</div><div>Br</div><div>Bromine</div><div>79.904</div></div>	36	<div><div>36</div><div>Kr</div><div>Krypton</div><div>83.798</div></div>		
37	<div><div>37</div><div>Rb</div><div>Rubidium</div><div>85.4678</div></div>	38	<div><div>38</div><div>Sr</div><div>Strontium</div><div>87.62</div></div>	39	<div><div>39</div><div>Y</div><div>Yttrium</div><div>88.90585</div></div>	40	<div><div>40</div><div>Zr</div><div>Zirconium</div><div>91.224</div></div>	41	<div><div>41</div><div>Nb</div><div>Niobium</div><div>92.90638</div></div>	42	<div><div>42</div><div>Mo</div><div>Molybdenum</div><div>95.96</div></div>	43	<div><div>43</div><div>Tc</div><div>Technetium</div><div>(97.9072)</div></div>	44	<div><div>44</div><div>Ru</div><div>Ruthenium</div><div>101.07</div></div>	45	<div><div>45</div><div>Rh</div><div>Rhodium</div><div>102.90550</div></div>	46	<div><div>46</div><div>Pd</div><div>Palladium</div><div>106.42</div></div>	47	<div><div>47</div><div>Ag</div><div>Silver</div><div>107.8682</div></div>	48	<div><div>48</div><div>Cd</div><div>Cadmium</div><div>112.411</div></div>	49	<div><div>49</div><div>In</div><div>Indium</div><div>114.818</div></div>	50	<div><div>50</div><div>Sn</div><div>Tin</div><div>118.710</div></div>	51	<div><div>51</div><div>Sb</div><div>Antimony</div><div>121.760</div></div>	52	<div><div>52</div><div>Te</div><div>Tellurium</div><div>127.60</div></div>	53	<div><div>53</div><div>I</div><div>Iodine</div><div>126.90447</div></div>	54	<div><div>54</div><div>Xe</div><div>Xenon</div><div>131.293</div></div>		
55	<div><div>55</div><div>Cs</div><div>Caesium</div><div>132.9054519</div></div>	56	<div><div>56</div><div>Ba</div><div>Barium</div><div>137.327</div></div>	57–71				72	<div><div>72</div><div>Hf</div><div>Hafnium</div><div>178.49</div></div>	73	<div><div>73</div><div>Ta</div><div>Tantalum</div><div>180.94788</div></div>	74	<div><div>74</div><div>W</div><div>Tungsten</div><div>183.84</div></div>	75	<div><div>75</div><div>Re</div><div>Rhenium</div><div>186.207</div></div>	76	<div><div>76</div><div>Os</div><div>Osmium</div><div>190.23</div></div>	77	<div><div>77</div><div>Ir</div><div>Iridium</div><div>192.217</div></div>	78	<div><div>78</div><div>Pt</div><div>Platinum</div><div>195.084</div></div>	79	<div><div>79</div><div>Au</div><div>Gold</div><div>196.966569</div></div>	80	<div><div>80</div><div>Hg</div><div>Mercury</div><div>200.59</div></div>	81	<div><div>81</div><div>Tl</div><div>Thallium</div><div>204.3833</div></div>	82	<div><div>82</div><div>Pb</div><div>Lead</div><div>207.2</div></div>	83	<div><div>83</div><div>Bi</div><div>Bismuth</div><div>208.98040</div></div>	84	<div><div>84</div><div>Po</div><div>Polonium</div><div>(209.9824)</div></div>	85	<div><div>85</div><div>At</div><div>Astatine</div><div>(210.9871)</div></div>	86	<div><div>86</div><div>Rn</div><div>Radon</div><div>(222.0176)</div></div>
87	<div><div>87</div><div>Fr</div><div>Francium</div><div>(223)</div></div>	88	<div><div>88</div><div>Ra</div><div>Radium</div><div>(226)</div></div>	89–103				104	<div><div>104</div><div>Rf</div><div>Rutherfordium</div><div>(261)</div></div>	105	<div><div>105</div><div>Db</div><div>Dubnium</div><div>(262)</div></div>	106	<div><div>106</div><div>Sg</div><div>Seaborgium</div><div>(266)</div></div>	107	<div><div>107</div><div>Bh</div><div>Bohrium</div><div>(264)</div></div>	108	<div><div>108</div><div>Hs</div><div>Hassium</div><div>(277)</div></div>	109	<div><div>109</div><div>Mt</div><div>Meitnerium</div><div>(268)</div></div>	110	<div><div>110</div><div>Ds</div><div>Darmstadtium</div><div>(271)</div></div>	111	<div><div>111</div><div>Rg</div><div>Roentgenium</div><div>(272)</div></div>	112	<div><div>112</div><div>Uub</div><div>Ununbium</div><div>(285)</div></div>	113	<div><div>113</div><div>Uut</div><div>Ununtrium</div><div>(284)</div></div>	114	<div><div>114</div><div>Uuq</div><div>Ununquadium</div><div>(289)</div></div>	115	<div><div>115</div><div>Uup</div><div>Ununpentium</div><div>(288)</div></div>	116	<div><div>116</div><div>Uuh</div><div>Ununhexium</div><div>(292)</div></div>	117	<div><div>117</div><div>Uus</div><div>Ununseptium</div><div>(291)</div></div>	118	<div><div>118</div><div>Uuo</div><div>Ununoctium</div><div>(294)</div></div>

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

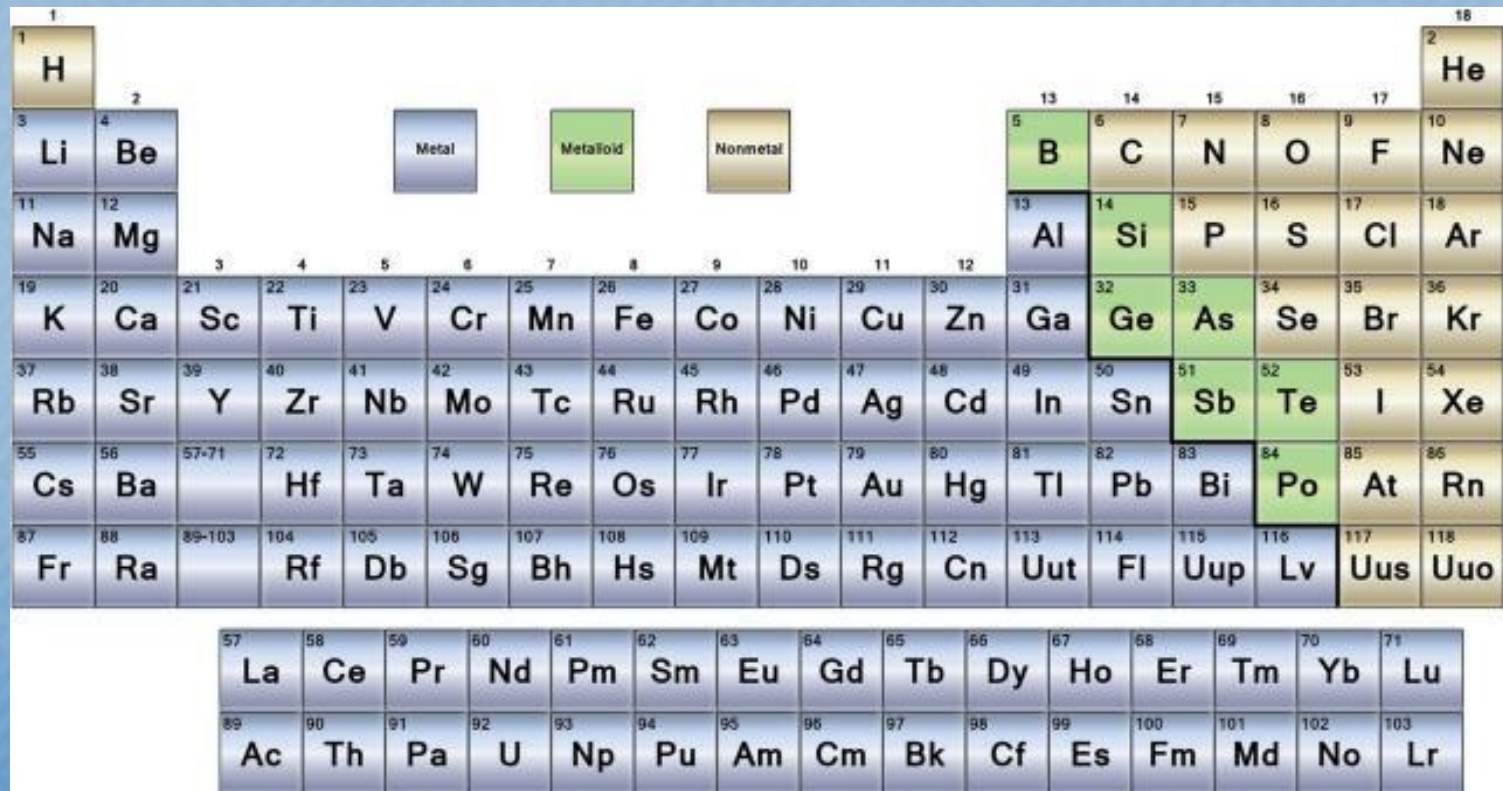
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57	La Lanthanum 138.90547	58	Ce Cerium 140.116	59	Pr Praseodymium 140.90765	60	Nd Neodymium 144.242	61	Pm Promethium (145)	62	Sm Samarium 150.36	63	Eu Europium 151.964	64	Gd Gadolinium 157.25	65	Tb Terbium 158.92535	66	Dy Dysprosium 162.500	67	Ho Holmium 164.93032	68	Er Erbium 167.259	69	Tm Thulium 168.93421	70	Yb Ytterbium 173.054	71	Lu Lutetium 174.9668
89	Ac Actinium (227)	90	Th Thorium 232.03806	91	Pa Protactinium 231.03588	92	U Uranium 238.02891	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 (252)	100	Fm Fermium (257)	101	Md Mendelevium (258)	102	No Nobelium (259)	103	Lr Lawrencium (262)

Types of elements:

Metal - good conductors of heat and electricity, malleable, ductile, lustrous and high tensile strength.

Nonmetal - poor conductor of heat and electricity.



The periodic table is shown with three regions highlighted: Metal (blue), Metalloid (green), and Nonmetal (yellow). The Metal region includes elements from Group 1 to 10, plus the transition metals in Groups 3-10. The Metalloid region includes elements from Groups 13 to 16. The Nonmetal region includes elements from Groups 17 and 18, plus the elements from Groups 13 to 16 that are not metalloids.

1	2											13	14	15	16	17	18
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57-71 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo
		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
		89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

Noble Gases - group 18 of the periodic table

* Lanthanide Series	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
+ Actinide Series	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr