

# How many states of matter can you find in each picture?



# Matter in Chemistry

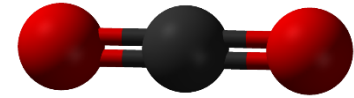
Ordinary matter is composed of atoms and groups of atoms *bonded* together, called molecules.

- There are many different types of atoms.
- Consequently, there are many possible combinations of two or more atoms that can chemically bond.

IA 1	H Hydrogen 1 1.01	IIA 2	Li Lithium 3 6.94	Be Beryllium 4 9.01	III A 13	B Boron 5 10.81	IIIA 13	C Carbon 6 12.01	IIIA 13	N Nitrogen 7 14.01	IIIA 13	O Oxygen 8 16.00	VIIA 17	F Fluorine 9 19.00	VIIA 17	Ne Neon 10 20.18																													
3	Na Sodium 11 22.99	Mg Magnesium 12 24.31	Al Aluminium 13 26.98	IIIA 13	Si Silicon 14 28.09	IIIA 13	P Phosphorus 15 30.97	IIIA 13	S Sulphur 16 32.06	VIIA 17	Cl Chlorine 17 35.45	VIIA 17	Ar Argon 18 39.95																																
4	K Potassium 19 39.10	Ca Calcium 20 40.08	Sc Scandium 21 44.96	IVB 4	Ti Titanium 22 47.88	VB 5	V Vanadium 23 50.94	VIB 6	Cr Chromium 24 52.00	VIB 6	Mn Manganese 25 54.94	VIB 6	Fe Iron 26 55.85	VIB 6	Co Cobalt 27 58.93	VIB 6	Ni Nickel 28 58.69	VIB 6	Cu Copper 29 63.55	VIB 6	Zn Zinc 30 65.39	VIB 6	Ga Gallium 31 69.72	VIB 6	Ge Germanium 32 72.61	VIB 6	As Arsenic 33 74.92	VIB 6	Se Selenium 34 78.96	VIB 6	Br Bromine 35 79.90	VIB 6	Kr Krypton 36 83.80												
5	Rb Rubidium 37 85.47	Sr Strontium 38 87.62	Y Yttrium 39 88.91	IVB 4	Zr Zirconium 40 91.22	VIB 6	Nb Niobium 41 92.91	VIB 6	Mo Molybdenum 42 95.94	VIB 6	Tc Technetium 43 (98)	VIB 6	Ru Ruthenium 44 101.07	VIB 6	Rh Rhodium 45 102.91	VIB 6	Pd Palladium 46 106.42	VIB 6	Ag Silver 47 107.87	VIB 6	Cd Cadmium 48 112.41	VIB 6	In Indium 49 114.82	VIB 6	Sn Tin 50 118.71	VIB 6	Sb Antimony 51 121.76	VIB 6	Te Tellurium 52 127.60	VIB 6	I Iodine 53 126.90	VIB 6	Xe Xenon 54 131.29												
6	Cs Caesium 55 132.91	Ba Barium 56 137.33	Lanthanide Series	VIB 6	Hf Hafnium 72 178.49	VIB 6	Ta Tantalum 73 180.95	VIB 6	W Tungsten 74 183.85	VIB 6	Re Rhenium 75 186.21	VIB 6	Os Osmium 76 190.23	VIB 6	Ir Iridium 77 192.22	VIB 6	Pt Platinum 78 195.08	VIB 6	Au Gold 79 196.97	VIB 6	Hg Mercury 80 200.59	VIB 6	Tl Thallium 81 204.38	VIB 6	Pb Lead 82 207.20	VIB 6	Bi Bismuth 83 208.98	VIB 6	Po Polonium 84 (209)	VIB 6	At Astatine 85 (210)	VIB 6	Rn Radon 86 (222)												
7	Fr Francium 87 (223)	Ra Radium 88 (226)	Actinide Series	VIB 6	Rf Rutherfordium 104 (261)	VIB 6	Db Dubnium 105 (262)	VIB 6	Sg Seaborgium 106 (263)	VIB 6	Bh Bohrium 107 (264)	VIB 6	Hs Hassium 108 (265)	VIB 6	Mt Meitnerium 109 (266)	VIB 6	La Lanthanum 57 138.91	VIB 6	Ce Cerium 58 140.12	VIB 6	Pr Praseodymium 59 140.91	VIB 6	Nd Neodymium 60 144.24	VIB 6	Pm Promethium 61 (145)	VIB 6	Sm Samarium 62 150.36	VIB 6	Eu Europium 63 151.96	VIB 6	Gd Gadolinium 64 157.25	VIB 6	Tb Terbium 65 158.93	VIB 6	Dy Dysprosium 66 162.50	VIB 6	Ho Holmium 67 164.93	VIB 6	Er Erbium 68 167.26	VIB 6	Tm Thulium 69 168.93	VIB 6	Yb Ytterbium 70 173.05	VIB 6	Lu Lutetium 71 174.96
	Ac Actinium 89 227.03	Th Thorium 90 232.04	Pa Protactinium 91 231.04	VIB 6	U Uranium 92 238.03	VIB 6	Np Neptunium 93 237.05	VIB 6	Pu Plutonium 94 244.06	VIB 6	Am Americium 95 243.06	VIB 6	Cm Curium 96 247.07	VIB 6	Bk Berkelium 97 247.07	VIB 6	Cf Californium 98 251.08	VIB 6	Es Einsteinium 99 252.08	VIB 6	Fm Fermium 100 257.10	VIB 6	Md Mendelevium 101 258.10	VIB 6	No Nihonium 102 289.10	VIB 6	Lr Lawrencium 103 260.10																		

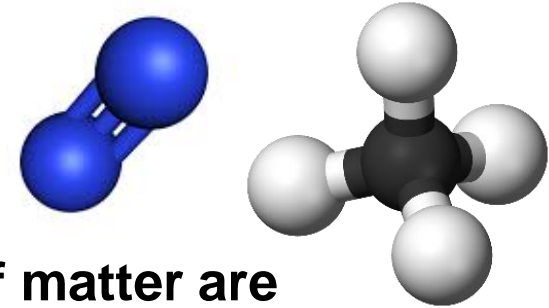


# Molecule

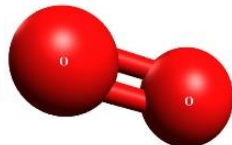
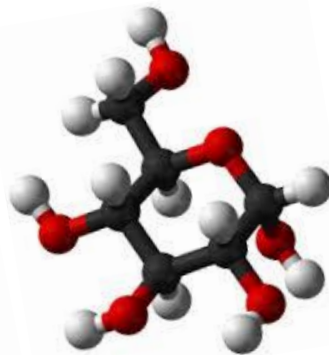
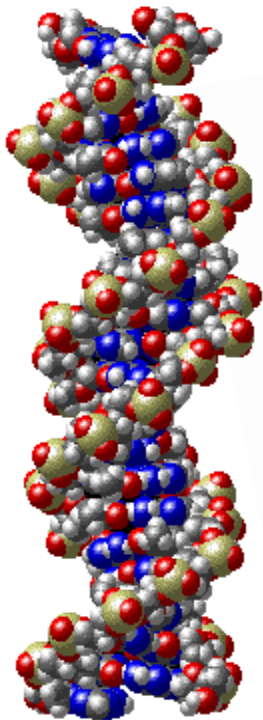


Molecules are **neutral groups of two or more atoms held together by chemical bonds.**

- Molecules can be thought of as the **smallest identifiable physical unit** of a chemical substance.



- Molecules as components of matter are common in organic substances. They also make up most of the oceans and atmosphere.



- However, the **majority of familiar solid substances on Earth**, including most of the minerals that make up the crust, mantle, and core of the Earth, contain many chemical bonds, but **are not made of identifiable molecules.**

# Simple inorganic molecules

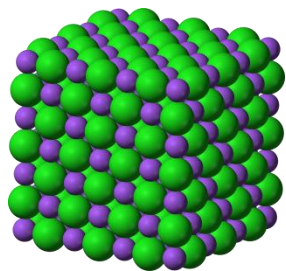
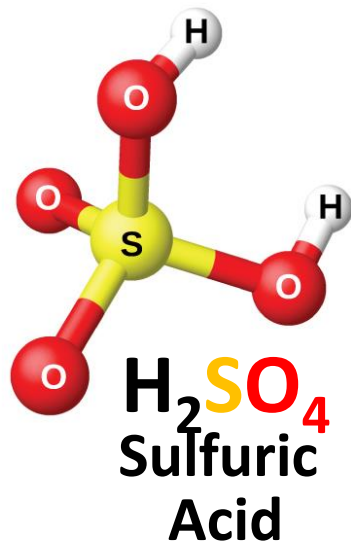
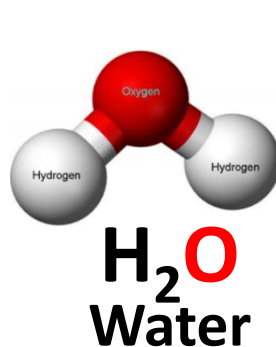
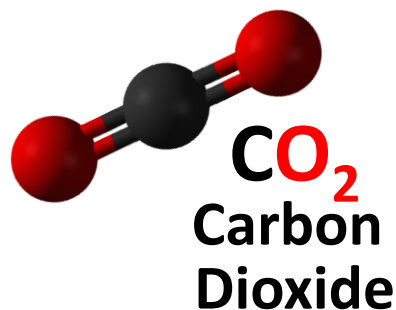
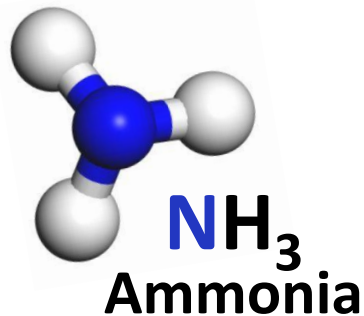
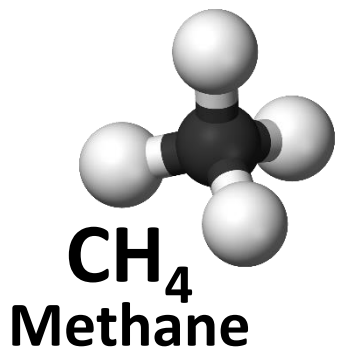


Table  
Salt  
crystal

# Chemical Substance

A chemical *substance* is a form of matter that has a definite chemical composition throughout and distinct characteristic properties.



glass

gold ingots



honey

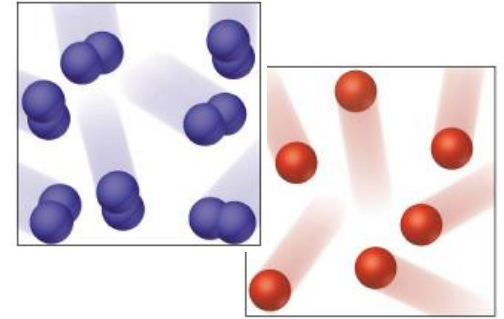
liquid nitrogen



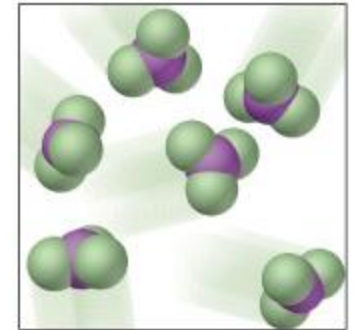
All ordinary matter can be classified *chemically* as either a *pure substance* or a *mixture*.

# Classification of Substances

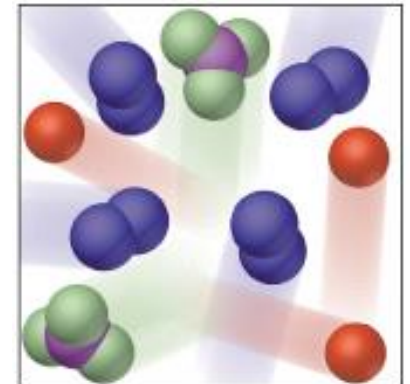
- Elements: substances that are made from **one type of atom** only.  
How many types are there?



- Compounds: substances that are made from **more than one** type of atom **chemically bonded** together.



- Mixtures: substances that are made from **more than one** type of atom **combined physically**, but not chemically bonded.



# Periodic Table of Elements

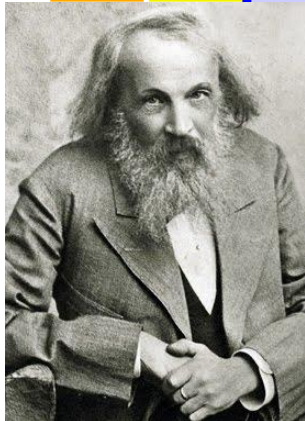
today, there are **118** known elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18														
1 <b>H</b> Hydrogen 1.00794	Atomic # Symbd Name Atomic Mass																2 <b>He</b> Helium 4.002602														
3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryllium 9.012182	<div style="display: flex; justify-content: space-between;"> <div style="width: 15%;"> <p><b>C</b> Solid</p> <p><b>Hg</b> Liquid</p> <p><b>H</b> Gas</p> <p><b>Rf</b> Unknown</p> </div> <div style="width: 60%; text-align: center;"> <p><b>Metals</b></p> <div style="display: flex; justify-content: space-around;"> <div style="background-color: yellow; padding: 2px;">Alkali metals</div> <div style="background-color: orange; padding: 2px;">Alkaline earth metals</div> <div style="background-color: lightblue; padding: 2px;">Lanthanoids</div> <div style="background-color: lightgreen; padding: 2px;">Transition metals</div> <div style="background-color: lightpurple; padding: 2px;">Actinoids</div> <div style="background-color: lightcyan; padding: 2px;">Poor metals</div> <div style="background-color: lightyellow; padding: 2px;">Other nonmetals</div> <div style="background-color: lightblue; padding: 2px;">Noble gases</div> </div> </div> <div style="width: 15%;"></div> </div>																5 <b>B</b> Boron 10.811	6 <b>C</b> Carbon 12.0107	7 <b>N</b> Nitrogen 14.0067	8 <b>O</b> Oxygen 15.9994	9 <b>F</b> Fluorine 18.9984032	10 <b>Ne</b> Neon 20.1797	11 <b>Na</b> Sodium 22.98976928	12 <b>Mg</b> Magnesium 24.3050	13 <b>Al</b> Aluminium 26.9815386	14 <b>Si</b> Silicon 28.0855	15 <b>P</b> Phosphorus 30.973762	16 <b>S</b> Sulfur 32.065	17 <b>Cl</b> Chlorine 35.453	18 <b>Ar</b> Argon 39.948
19 <b>K</b> Potassium 39.0983	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.955912	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> Vanadium 50.9415	24 <b>Cr</b> Chromium 51.9961	25 <b>Mn</b> Manganese 54.938045	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933195	28 <b>Ni</b> Nickel 58.6934	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.38	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.64	33 <b>As</b> Arsenic 74.92160	34 <b>Se</b> Selenium 78.96	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.798														
37 <b>Rb</b> Rubidium 85.4678	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.90585	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.90638	42 <b>Mo</b> Molybdenum 95.96	43 <b>Tc</b> Technetium (97.9072)	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.90550	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.8682	48 <b>Cd</b> Cadmium 112.411	49 <b>In</b> Indium 114.818	50 <b>Sn</b> Tin 118.710	51 <b>Sb</b> Antimony 121.760	52 <b>Te</b> Tellurium 127.60	53 <b>I</b> Iodine 126.90447	54 <b>Xe</b> Xenon 131.293														
55 <b>Cs</b> Caesium 132.9054519	56 <b>Ba</b> Barium 137.327	57-71		72 <b>Hf</b> Hafnium 178.49	73 <b>Ta</b> Tantalum 180.94788	74 <b>W</b> Tungsten 183.84	75 <b>Re</b> Rhenium 186.207	76 <b>Os</b> Osmium 190.23	77 <b>Ir</b> Iridium 192.217	78 <b>Pt</b> Platinum 195.084	79 <b>Au</b> Gold 196.966569	80 <b>Hg</b> Mercury 200.59	81 <b>Tl</b> Thallium 204.3833	82 <b>Pb</b> Lead 207.2	83 <b>Bi</b> Bismuth 208.98040	84 <b>Po</b> Polonium (208.9824)	85 <b>At</b> Astatine (209.9871)	86 <b>Rn</b> Radon (222.0178)													
87 <b>Fr</b> Francium (223)	88 <b>Ra</b> Radium (226)	89-103		104 <b>Rf</b> Rutherfordium (261)	105 <b>Db</b> Dubnium (262)	106 <b>Sg</b> Seaborgium (266)	107 <b>Bh</b> Bohrium (264)	108 <b>Hs</b> Hassium (277)	109 <b>Mt</b> Meitnerium (268)	110 <b>Ds</b> Darmstadtium (271)	111 <b>Rg</b> Roentgenium (272)	112 <b>Uub</b> Ununbium (285)	113 <b>Uut</b> Ununtrium (284)	114 <b>Uuq</b> Ununquadium (289)	115 <b>Uup</b> Ununpentium (288)	116 <b>Uuh</b> Ununhexium (292)	117 <b>Uus</b> Ununseptium	118 <b>Uuo</b> Ununoctium (294)													

94 naturally occurring elements and 24 synthetic (man-made)

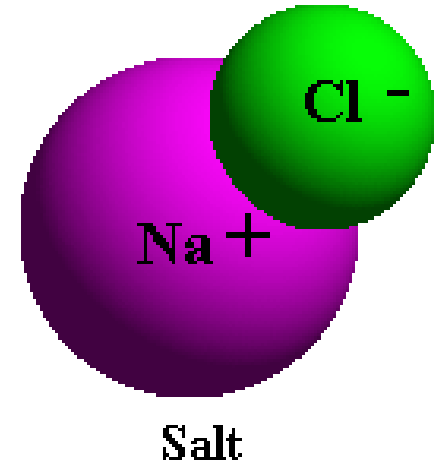
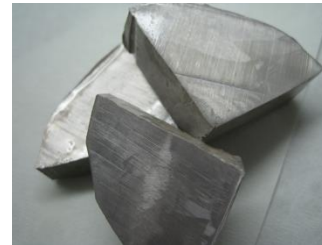
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57 <b>La</b> Lanthanum 138.90547	58 <b>Ce</b> Cerium 140.116	59 <b>Pr</b> Praseodymium 140.90785	60 <b>Nd</b> Neodymium 144.242	61 <b>Pm</b> Promethium (145)	62 <b>Sm</b> Samarium 150.36	63 <b>Eu</b> Europium 151.964	64 <b>Gd</b> Gadolinium 157.25	65 <b>Tb</b> Terbium 158.92535	66 <b>Dy</b> Dysprosium 162.500	67 <b>Ho</b> Holmium 164.93032	68 <b>Er</b> Erbium 167.259	69 <b>Tm</b> Thulium 168.93421	70 <b>Yb</b> Ytterbium 173.054	71 <b>Lu</b> Lutetium 174.968
89 <b>Ac</b> Actinium (227)	90 <b>Th</b> Thorium 232.03806	91 <b>Pa</b> Protactinium 231.03588	92 <b>U</b> Uranium 238.02891	93 <b>Np</b> Neptunium (237)	94 <b>Pu</b> Plutonium (244)	95 <b>Am</b> Americium (243)	96 <b>Cm</b> Curium (247)	97 <b>Bk</b> Berkelium (247)	98 <b>Cf</b> Californium (251)	99 <b>Es</b> Einsteinium (252)	100 <b>Fm</b> Fermium (257)	101 <b>Md</b> Mendelevium (258)	102 <b>No</b> Nobelium (259)	103 <b>Lr</b> Lawrencium (262)



# Elements and Compounds

- Sodium is an **element**.
- Chlorine is an **element**.
- When **sodium** and **chlorine** **bond** they make up the **compound sodium chloride**, commonly known as **table salt**.



**Compounds have *different properties than the elements that make them up:***

**for example, table salt** has different properties than **sodium**, an **explosive metal**, and **chlorine**, a **poisonous gas**.



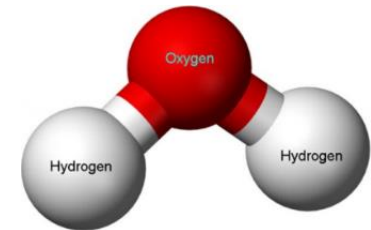
# Elements, Compounds, Mixtures

- Hydrogen is an **element**.
- Oxygen is an **element**.
- When **hydrogen** and **oxygen** **bond** they make the **compound water**.
- When **salt** and **water** are **combined**, a **mixture** is created.

**Components in mixtures  
retain their individual  
properties.**



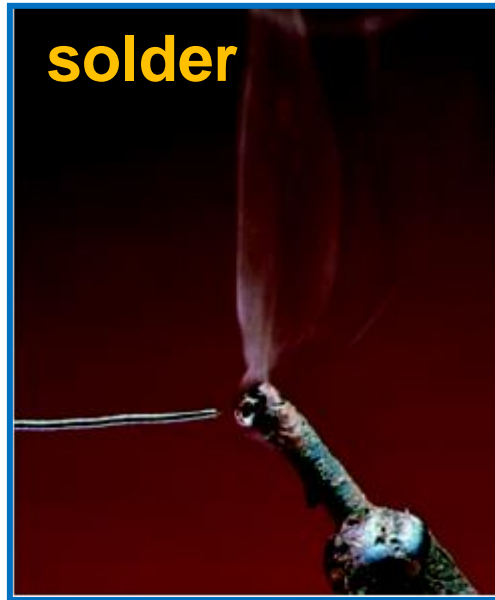
Water is a **compound**



Ocean water is a **mixture**

# Types of Mixtures

- **Homogeneous** – composition of the mixture is the same throughout; only one state of matter is present.



- **Heterogeneous** – composition is not uniform throughout.



# Element, Compound, or Mixture?



**Pure Water**



**Copper**



**Diamond**



**Jelly Beans**