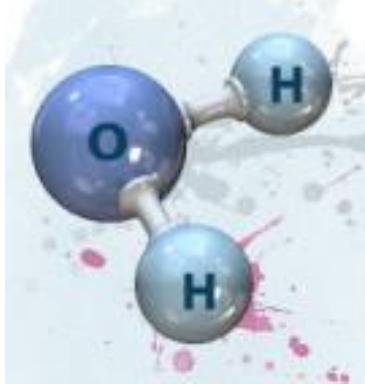


# Matter in Chemistry

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.

1	IA	H	Hydrogen 1 1.01	IIA	Li	Lithium 3 6.94	III A	Be	Beryllium 4 9.07	IV A	Mg	Magnesium 12 24.31	V A	Na	Sodium 11 22.99	VI A	K	Potassium 19 39.10	VII A	Ca	Calcium 20 40.08	VIII A	Rb	Rubidium 37 85.47	1A	Sr	Strontrium 38 87.62	2A	Y	Yttrium 39 88.91	3A	Zr	Zirconium 40 91.22	4A	Nb	Niobium 41 92.91	5A	Mo	Molybdenum 42 95.94	6A	Tc	Technetium 43 (98)	7A	Fe	Iron 26 55.85	8A	Co	Cobalt 27 58.93	9A	Ni	Nickel 28 58.69	10A	Cu	Copper 29 63.55	11A	Zn	Zinc 30 65.39	12A	Ga	Gallium 31 69.72	13A	Ge	Germanium 32 72.61	14A	O	Oxygen 8 16.00	15A	N	Nitrogen 7 14.01	16A	Si	Silicon 14 28.09	17A	F	Fluorine 9 19.00	18A	Ne	Neon 10 20.18	1	Ar	Argon 18 39.97	2	Cl	Chlorine 17 35.45	3	Kr	Krypton 36 83.80	4	Br	Bromine 35 79.90	5	Se	Selenium 34 78.96	6	I	Iodine 53 126.50	7	Xe	Xenon 54 131.29	8	Rn	Radon 86 (222)	9	At	Astatine 85 (210)	10	Lu	Lutetium 71 174.96
1	IA	Fr	Francium 87 (223)	IIA	Ra	Radium 88 (226)	III A	Ac	Actinium 89 227.09	IV A	Th	Thorium 90 232.03	V A	Pa	Protactinium 91 231.03	VI A	U	Uranium 92 238.02	VII A	Np	Neptunium 93 237.01	1A	Pu	Plutonium 94 239.01	2A	Am	Americium 95 (243)	3A	Cm	Curium 96 (244)	4A	Bk	Berkelium 97 (247)	5A	Cf	Californium 98 (249)	6A	Es	Einsteinium 99 (251)	7A	Fm	Fermium 100 (252)	8A	Md	Mendelevium 101 (256)	9A	No	Nobelium 102 (259)	10A	Lr	Lutherfordium 103 (260)																																																									
1	IA	FEST	Foundation for Education, Science & Technology	IIA	Ac	Actinium 89 227.09	III A	Th	Thorium 90 232.03	IV A	Pa	Protactinium 91 231.03	V A	U	Uranium 92 238.02	VI A	Np	Neptunium 93 237.01	VII A	Pu	Plutonium 94 239.01	1A	Am	Americium 95 (243)	2A	Cm	Curium 96 (244)	3A	Bk	Berkelium 97 (247)	4A	Cf	Californium 98 (249)	5A	Es	Einsteinium 99 (251)	6A	Fm	Fermium 100 (252)	7A	Md	Mendelevium 101 (256)	8A	No	Nobelium 102 (259)	9A	Lr	Lutherfordium 103 (260)																																																												

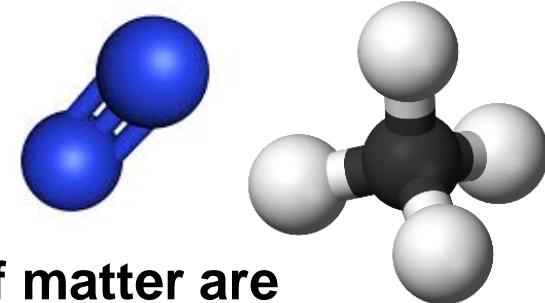


# Molecule



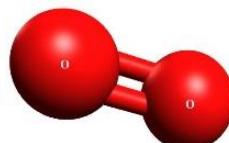
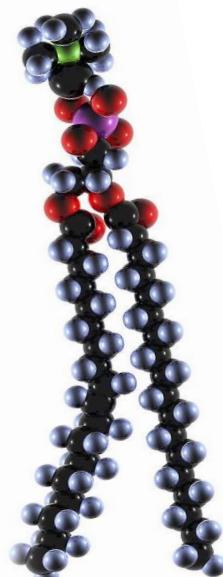
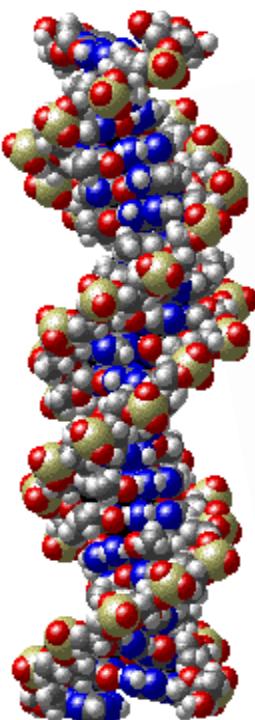
Molecules are neutral groups of two or more atoms held together by chemical bonds.

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

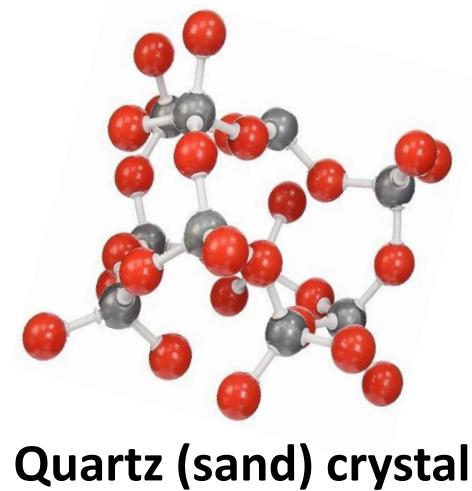
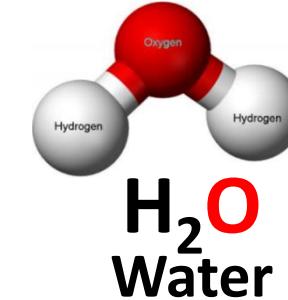
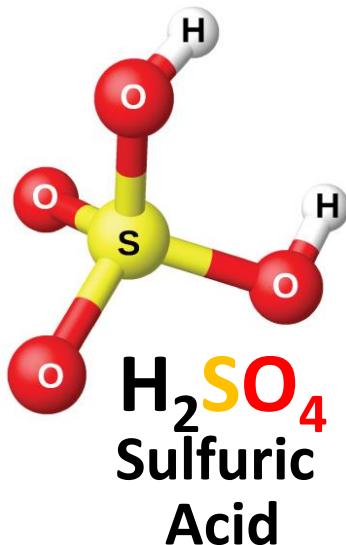
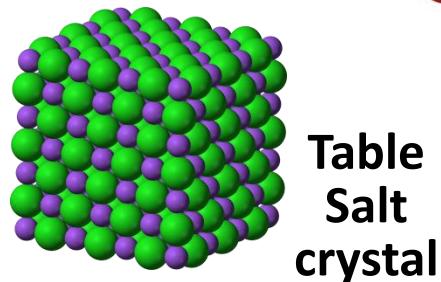
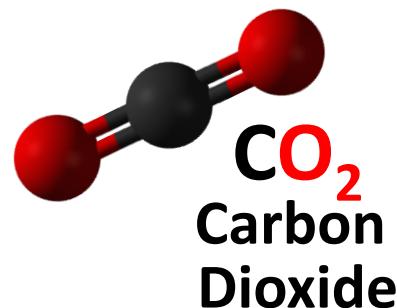
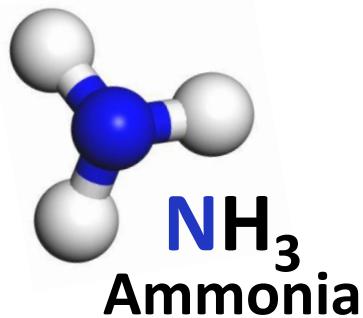
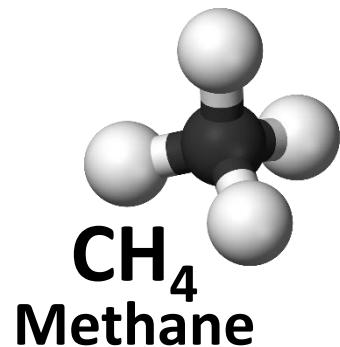


- Molecules as components of matter are common in organic substances. They also make up most of the oceans and atmosphere.

- 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



# 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



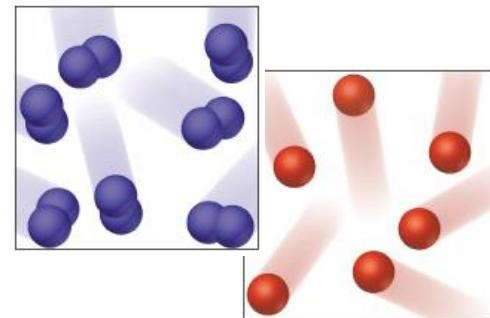
liquid  
nitrogen

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

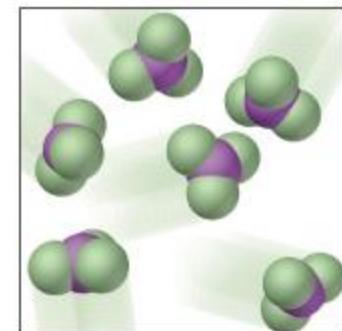
# Classification of Substances

- **Elements:** substances that are made from **one type of atom only.**

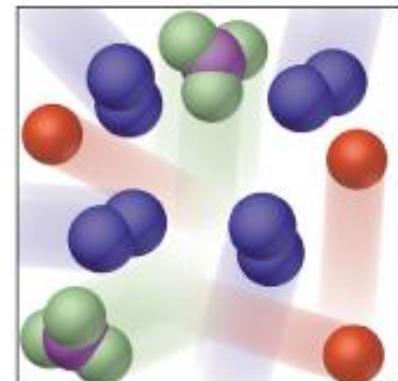
How many types are there?



- **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	1 <b>H</b> Hydrogen 1.00794	1 <b>C</b> Solid	1 <b>Hg</b> Liquid	1 <b>H</b> Gas	1 <b>Rf</b> Unknown	Metals	Nonmetals	2 <b>He</b> Helium 4.002602	2 <b>He</b> Helium 4.002602	2 <b>K</b> K	2 <b>B</b> Boron 10.811	2 <b>C</b> Carbon 12.0107	2 <b>N</b> Nitrogen 14.0067	2 <b>O</b> Oxygen 15.9994	2 <b>F</b> Fluorine 18.994032	2 <b>Ne</b> Neon 20.1797	2 <b>Ar</b> Argon 39.948	2 <b>KLM</b> KLM																																																					
3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryllium 9.012182	5 <b>Alkali metals</b>	6 <b>Alkaline earth metals</b>	7 <b>Lanthanoids</b>	8 <b>Transition metals</b>	9 <b>Poor metals</b>	10 <b>Other nonmetals</b>	11 <b>Noble gases</b>	12 <b>B</b> Boron 10.811	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>Br</b> Bromine 79.904	19 <b>Kr</b> Krypton 83.798	20 <b>KLMN</b> KLMN																																																						
11 <b>Na</b> Sodium 22.98976928	12 <b>Mg</b> Magnesium 24.3050	21 <b>Sc</b> Scandium 44.955912	22 <b>Ti</b> Titanium 47.887	23 <b>V</b> Vanadium 50.9415	24 <b>Cr</b> Chromium 51.9861	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 63.548	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 75.98	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 95.98	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 107.8862	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 121.780	52 <b>Tl</b> Tellurium 127.80	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 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 196.996569	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 (222.0176)	87 <b>Fr</b> Francium (223)	88 <b>Ra</b> Radium (226)	89-103 89-103	104 <b>Rf</b> Rutherfordium (261)	105 <b>Db</b> Dubnium (262)	106 <b>Sg</b> Seaborgium (263)	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>Uup</b> Ununpentium (288)	115 <b>Uuo</b> Ununoctium (292)	116 <b>Uuh</b> Ununhexium (293)	117 <b>Uus</b> Ununocto (294)	118 <b>Uuo</b> Ununocto (294)

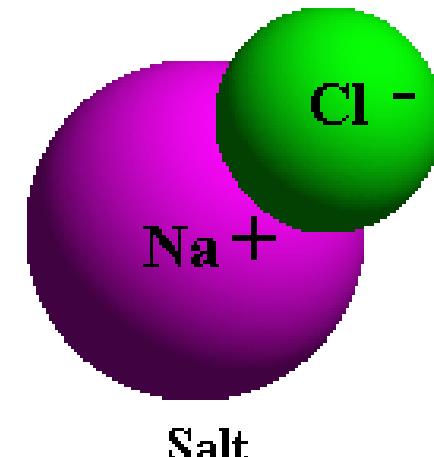
**94 naturally occurring elements and 24 synthetic (man-made)**

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<b>57</b> <b>La</b> Lanthanum 138.90547	<b>58</b> <b>Ce</b> Cerium 140.116	<b>59</b> <b>Pr</b> Praseodymium 140.90785	<b>60</b> <b>Nd</b> Neodymium 144.242	<b>61</b> <b>Pm</b> Promethium (145)	<b>62</b> <b>Sm</b> Samarium 150.36	<b>63</b> <b>Eu</b> Europium 151.964	<b>64</b> <b>Gd</b> Gadolinium 157.25	<b>65</b> <b>Tb</b> Terbium 158.92535	<b>66</b> <b>Dy</b> Dysprosium 162.500	<b>67</b> <b>Ho</b> Holmium 164.93302	<b>68</b> <b>Er</b> Erbium 167.259	<b>69</b> <b>Tm</b> Thulium 168.93421	<b>70</b> <b>Yb</b> Ytterbium 173.054	<b>71</b> <b>Lu</b> Lutetium 174.9688
<b>89</b> <b>Ac</b> Actinium (227)	<b>90</b> <b>Th</b> Thorium 232.03806	<b>91</b> <b>Pa</b> Protactinium 231.03588	<b>92</b> <b>U</b> Uranium 238.02881	<b>93</b> <b>Np</b> Neptunium (237)	<b>94</b> <b>Pu</b> Plutonium (244)	<b>95</b> <b>Am</b> Americium (243)	<b>96</b> <b>Cm</b> Curium (247)	<b>97</b> <b>Bk</b> Berkelium (247)	<b>98</b> <b>Cf</b> Californium (251)	<b>99</b> <b>Es</b> Einsteinium (252)	<b>100</b> <b>Fm</b> Fermium (257)	<b>101</b> <b>Md</b> Mendelevium (258)	<b>102</b> <b>No</b> Nobelium (259)	<b>103</b> <b>Lr</b> Lawrencium (258)

# 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.

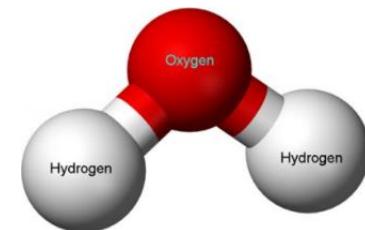
# Elements, Compounds, Mixtures

- 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.*

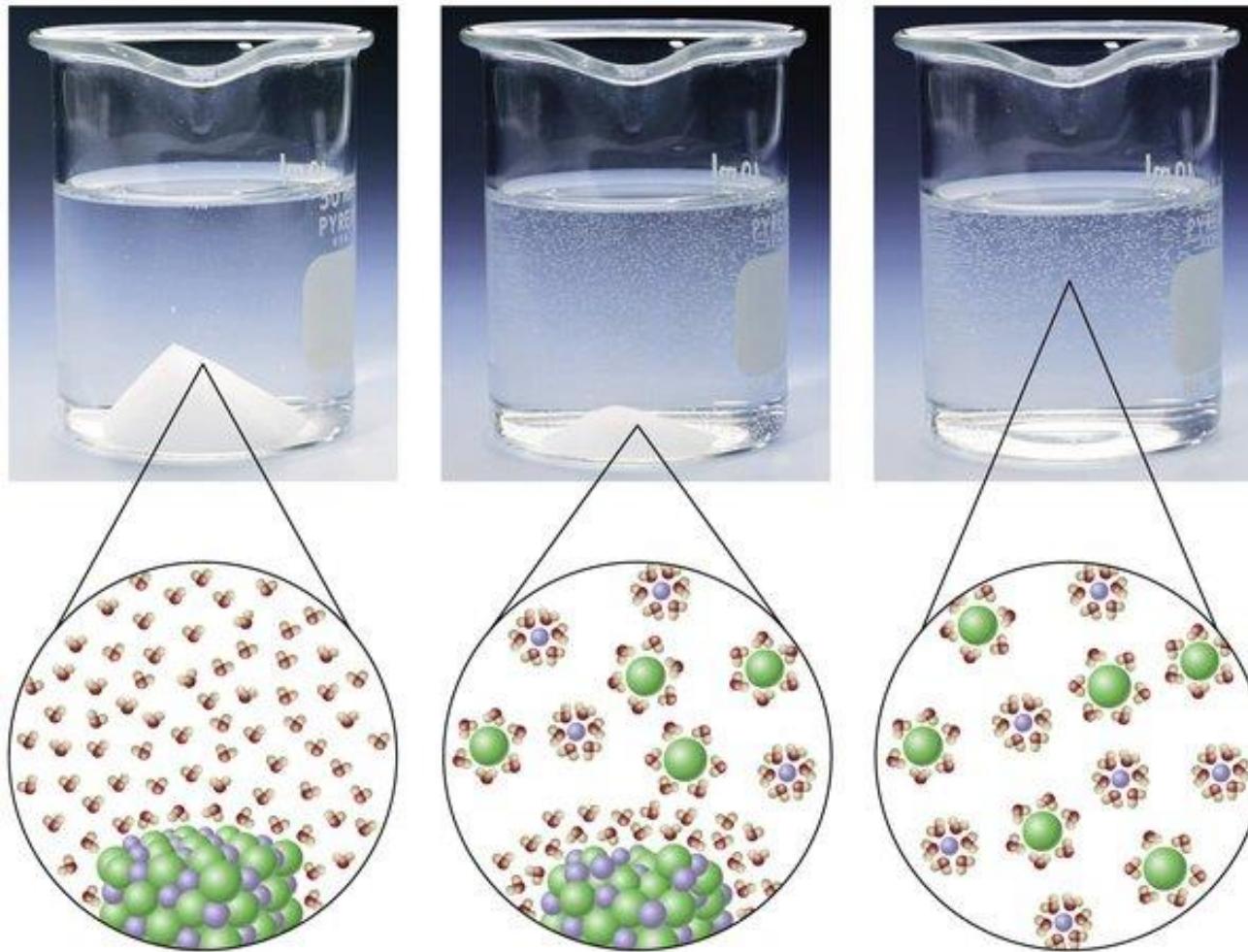


Water is a **compound**



Ocean water is a **mixture**

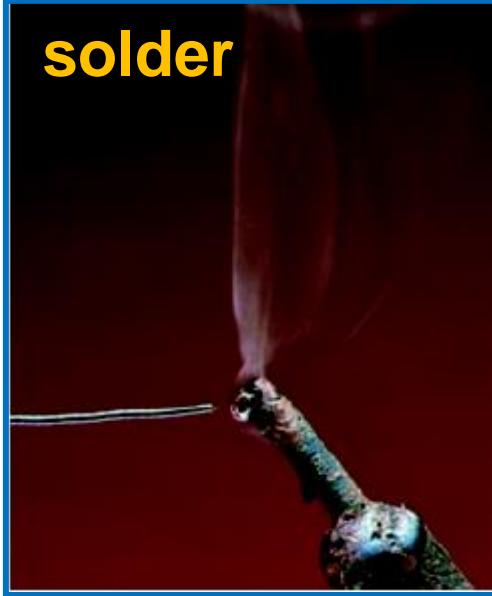
# Example: Salt Dissolving in Water



a homogeneous (uniform) MIXTURE is created

# 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