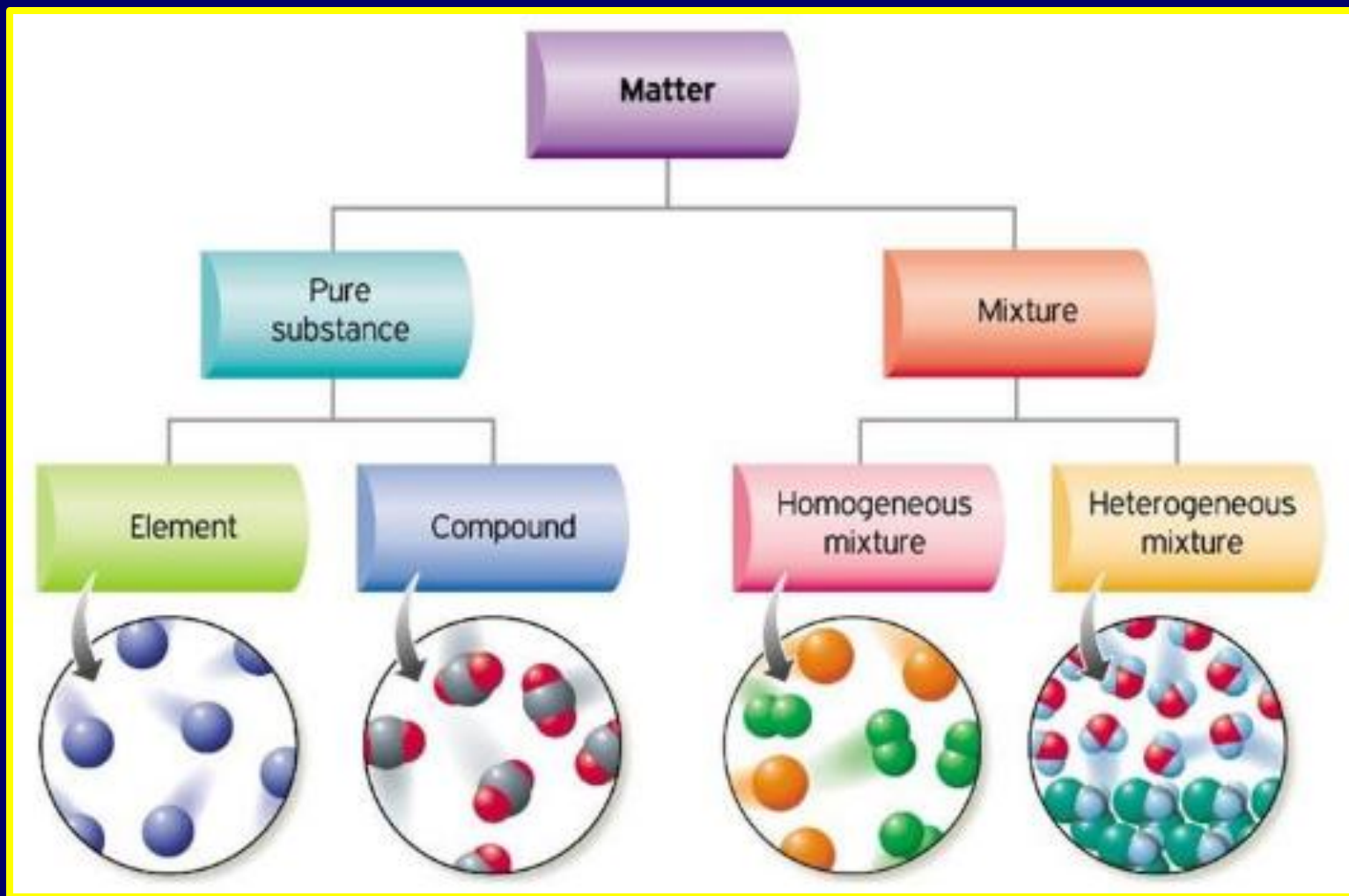


# Classification of Matter



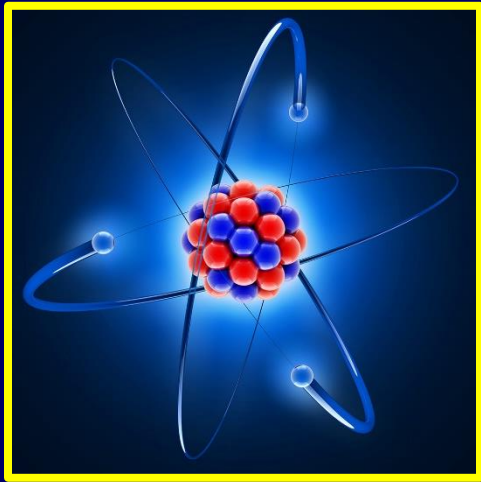
# I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can distinguish between elements, compounds, homogeneous mixtures, and heterogeneous mixtures.
- I can determine how many different elements are in a compound, based on its chemical formula.

# Matter

Matter is anything that has mass and takes up space.



All matter is composed of atoms.

The properties of various types of matter is determined by its atomic composition.

# Pure Substance

Any sample of matter that has a fixed composition or is always the same no matter what sample is examined, is called a pure substance.

Sucrose - Table Sugar –  $C_{12}H_{22}O_{11}$



# Pure Substance

Pure substances can be either elements or compounds.



# Elements

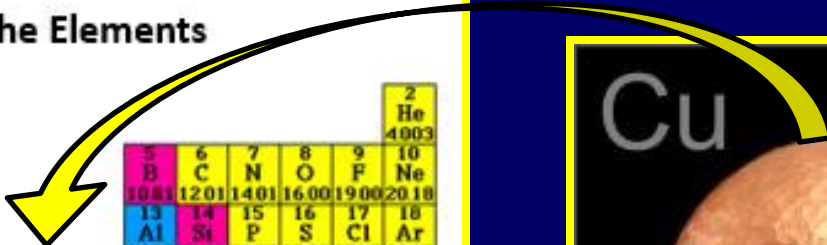
Elements are substances in which all the atoms are the same.



# Periodic Table

All Elements are found on the periodic table and can be identified by a chemical symbol.

Periodic Table of the Elements

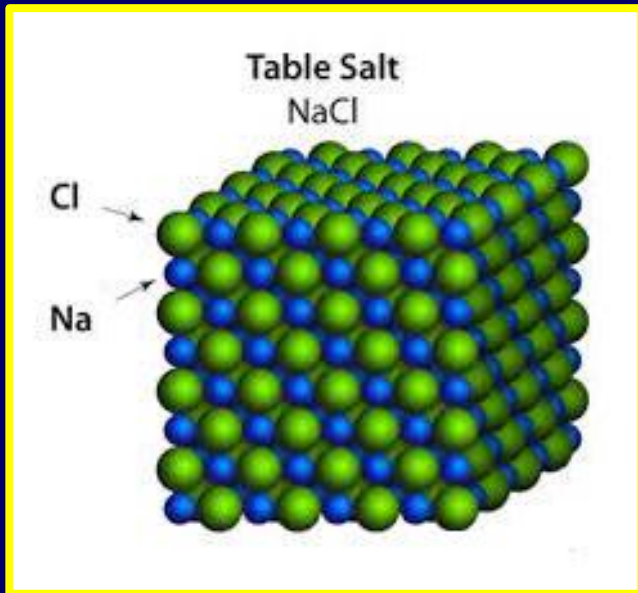


|                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|
| 1<br>H<br>1.008   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    | 2<br>He<br>4.003  |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |
| 3<br>Li<br>6.941  | 4<br>Be<br>9.012  |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    | 5<br>B<br>10.81    | 6<br>C<br>12.01   | 7<br>N<br>14.01   | 8<br>O<br>16.00   | 9<br>F<br>19.00   | 10<br>Ne<br>20.18 |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |
| 11<br>Na<br>23.00 | 12<br>Mg<br>24.31 |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    | 13<br>Al<br>26.98  | 14<br>Si<br>28.09 | 15<br>P<br>30.97  | 16<br>S<br>32.06  | 17<br>Cl<br>35.45 | 18<br>Ar<br>39.95 |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |
| 19<br>K<br>39.10  | 20<br>Ca<br>40.08 | 21<br>Sc<br>44.96 | 22<br>Ti<br>47.88 | 23<br>V<br>50.94  | 24<br>Cr<br>52.00 | 25<br>Mn<br>54.94 | 26<br>Fe<br>55.85 | 27<br>Co<br>58.93 | 28<br>Ni<br>58.69 | 29<br>Cu<br>63.55 | 30<br>Zn<br>65.38 | 31<br>Ga<br>69.72 | 32<br>Ge<br>72.64  | 33<br>As<br>74.92  | 34<br>Se<br>78.96  | 35<br>Br<br>79.90  | 36<br>Kr<br>83.80 |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |
| 37<br>Rb<br>85.47 | 38<br>Sr<br>87.62 | 39<br>Y<br>88.91  | 40<br>Zr<br>91.22 | 41<br>Nb<br>92.91 | 42<br>Mo<br>95.94 | 43<br>Tc<br>(98)  | 44<br>Ru<br>101.1 | 45<br>Rh<br>102.9 | 46<br>Pd<br>106.4 | 47<br>Ag<br>107.9 | 48<br>Cd<br>112.4 | 49<br>In<br>114.8 | 50<br>Sn<br>118.7  | 51<br>Sb<br>121.8  | 52<br>Te<br>127.6  | 53<br>I<br>126.9   | 54<br>Xe<br>131.3 |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |
| 55<br>Cs<br>132.9 | 56<br>Ba<br>137.3 | 57<br>La<br>138.9 | 58<br>Ce<br>140.9 | 59<br>Pr<br>140.9 | 60<br>Nd<br>144.2 | 61<br>Pm<br>(145) | 62<br>Sm<br>150.4 | 63<br>Eu<br>152.0 | 64<br>Gd<br>157.3 | 65<br>Tb<br>158.9 | 66<br>Dy<br>162.5 | 67<br>Ho<br>164.9 | 68<br>Er<br>167.3  | 69<br>Tm<br>168.9  | 70<br>Yb<br>173.0  | 71<br>Lu<br>175.0  |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |
| 87<br>Fr<br>(223) | 88<br>Ra<br>(226) | 89<br>Ac<br>(227) | 90<br>Th<br>(232) | 91<br>Pa<br>(231) | 92<br>U<br>(238)  | 93<br>Np<br>(237) | 94<br>Pu<br>(244) | 95<br>Am<br>(243) | 96<br>Cm<br>(247) | 97<br>Bk<br>(247) | 98<br>Cf<br>(251) | 99<br>Es<br>(252) | 100<br>Fm<br>(257) | 101<br>Md<br>(258) | 102<br>No<br>(259) | 103<br>Lr<br>(260) |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |
|                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |                   | 5<br>B<br>10.81   | 6<br>C<br>12.01   | 7<br>N<br>14.01   | 8<br>O<br>16.00   | 9<br>F<br>19.00   | 10<br>Ne<br>20.18 |                   |                   |                   |                   |                    |                    |                    |                    |
|                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |                   | 13<br>Al<br>26.98 | 14<br>Si<br>28.09 | 15<br>P<br>30.97  | 16<br>S<br>32.06  | 17<br>Cl<br>35.45 | 18<br>Ar<br>39.95 |                   |                   |                   |                   |                    |                    |                    |                    |
|                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |                   | 31<br>Ga<br>69.72 | 32<br>Ge<br>72.64 | 33<br>As<br>74.92 | 34<br>Se<br>78.96 | 35<br>Br<br>79.90 | 36<br>Kr<br>83.80 |                   |                   |                   |                   |                    |                    |                    |                    |
|                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |                   | 49<br>In<br>114.8 | 50<br>Sn<br>118.7 | 51<br>Sb<br>121.8 | 52<br>Te<br>127.6 | 53<br>I<br>126.9  | 54<br>Xe<br>131.3 |                   |                   |                   |                   |                    |                    |                    |                    |
|                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |                   | 81<br>Tl<br>204.4 | 82<br>Pb<br>207.2 | 83<br>Bi<br>209.0 | 84<br>Po<br>(209) | 85<br>At<br>(210) | 86<br>Rn<br>(222) |                   |                   |                   |                   |                    |                    |                    |                    |
|                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |                   | 58<br>Ce<br>140.1 | 59<br>Pr<br>140.9 | 60<br>Nd<br>144.2 | 61<br>Pm<br>(145) | 62<br>Sm<br>150.4 | 63<br>Eu<br>152.0 | 64<br>Gd<br>157.3 | 65<br>Tb<br>158.9 | 66<br>Dy<br>162.5 | 67<br>Ho<br>164.9 | 68<br>Er<br>167.3  | 69<br>Tm<br>168.9  | 70<br>Yb<br>173.0  | 71<br>Lu<br>175.0  |
|                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |                   | 90<br>Th<br>232.0 | 91<br>Pa<br>231.0 | 92<br>U<br>238.0  | 93<br>Np<br>(244) | 94<br>Pu<br>(243) | 95<br>Am<br>(247) | 96<br>Cm<br>(247) | 97<br>Bk<br>(251) | 98<br>Cf<br>(252) | 99<br>Es<br>(257) | 100<br>Fm<br>(258) | 101<br>Md<br>(259) | 102<br>No<br>(259) | 103<br>Lr<br>(260) |



# Compounds

Compounds are substances made up of two or more different elements that are chemically combined in a consistent manner.





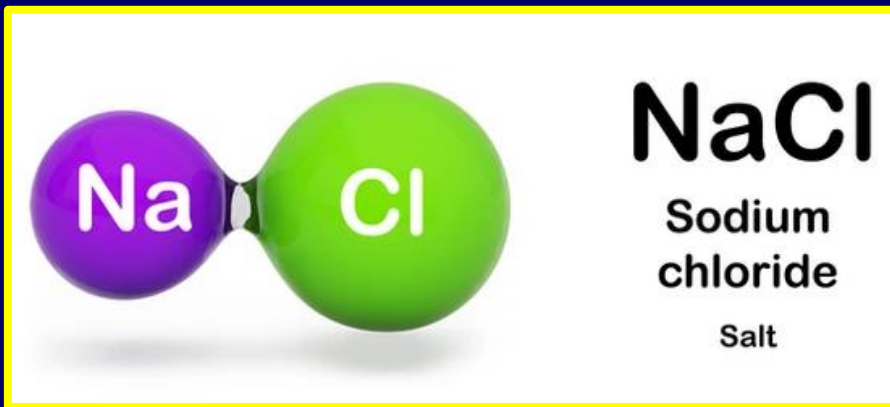
# Chemical Formulas

Compounds can be identified by their chemical formulas.



# Chemical Formulas

Chemical formulas are used to express the type of atoms and ratio of atoms present in a compound.

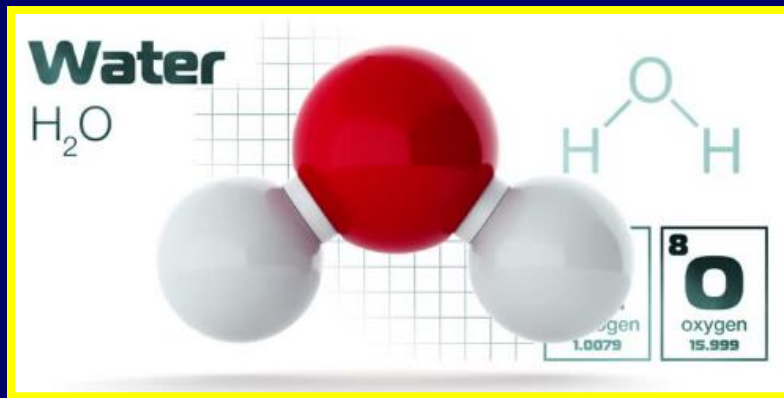


**1 Na atom**

**1 Cl atom**

# Subscripts

Subscripts, written after the element, identify the number of atoms there are of each element in a compound.



2 Hydrogen atoms

1 Oxygen atom

The number 1 is not written in chemical formulas.

# Common Compounds

Sand



3 atoms



Cane Sugar



45 atoms



Limestone

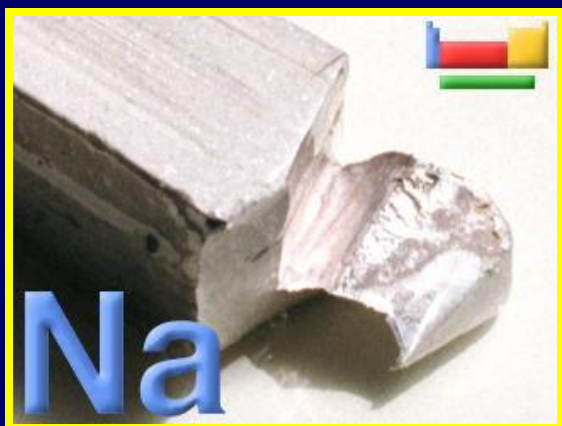


4 atoms



# Chemical Reactions

Compounds are formed through chemical reactions.



+



Sodium and Chlorine

Sodium Chloride  
(NaCl)



Table Salt

# Compound Properties

Once chemically combined, the properties of compounds are different than the properties of its individual elements.



Explosive



Non- Poisonous



Poisonous

# Mixtures

Mixtures are a combination of two or more substances that are not chemically bonded together.



# No Chemical Reaction

Because mixtures are not chemically bonded together, they can be formed or separated without a chemical reaction taking place.



Mixing a batch of Kool Aid



Using a Magnet to separate out metals



# Mixtures Retain Properties

Individual components of mixtures retain their individual properties.



# Types of Mixtures

There are several different types of mixtures, based on how evenly the substances are mixed together.



# Homogeneous Mixture

Homogeneous mixtures are those in which the substances are evenly mixed throughout.



# Solutions

Homogeneous mixtures are often called solutions because their individual substances cannot be distinguished even under a microscope.



# Solids, Liquids, or Gases

Homogenous mixtures can be solids, liquids, or gases.



**Stainless Steel**

Iron, Nickel, and Chromium



**Sweet Tea**

Water  
Tea  
Sugar  
Ice

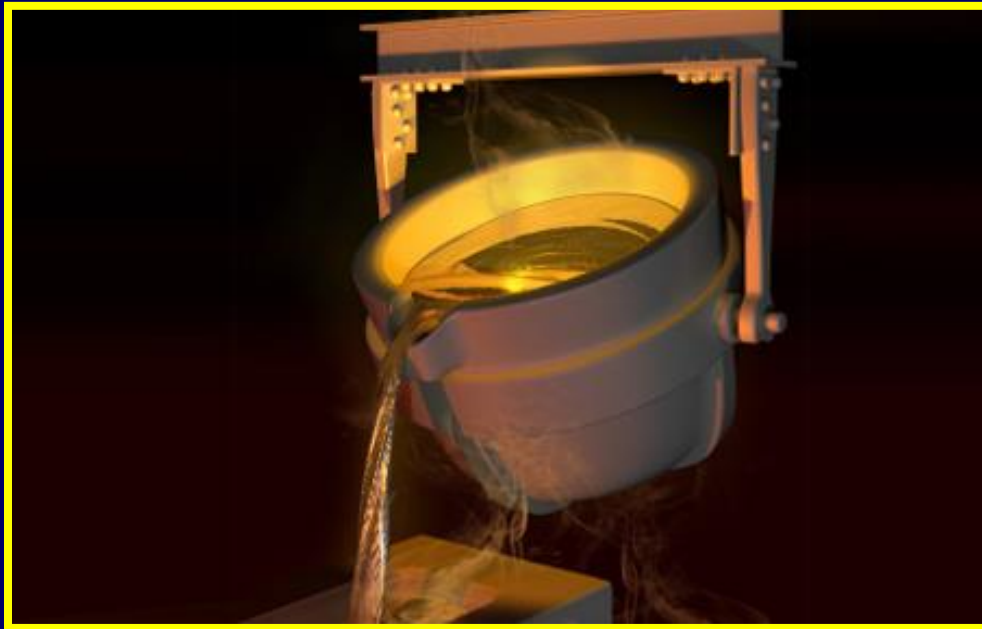


**Clean Air**

78% Nitrogen  
21% Oxygen  
1% Other Gases  
Water Vapor  
Carbon Dioxide  
Methane

# Metal Alloys

When two or more metals are melted down into liquid form, mixed together, and then allowed to solidify, they are called metal alloys.



# Metal Alloys

Metal alloys are created to improve the performance of metals and give them more desirable characteristics.



For example, mixing chromium with iron to create stainless steel prevents rusting.

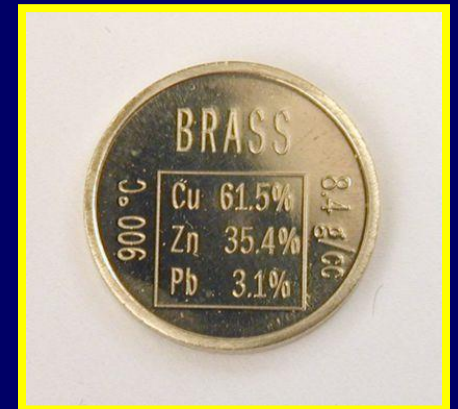
# Common Metal Alloys

Common metal alloys include: steel, bronze, brass, sterling silver, and different karat gold.



Bronze is an alloy made from copper and tin. It was made as early as 3,000 BC for tools and weapons.

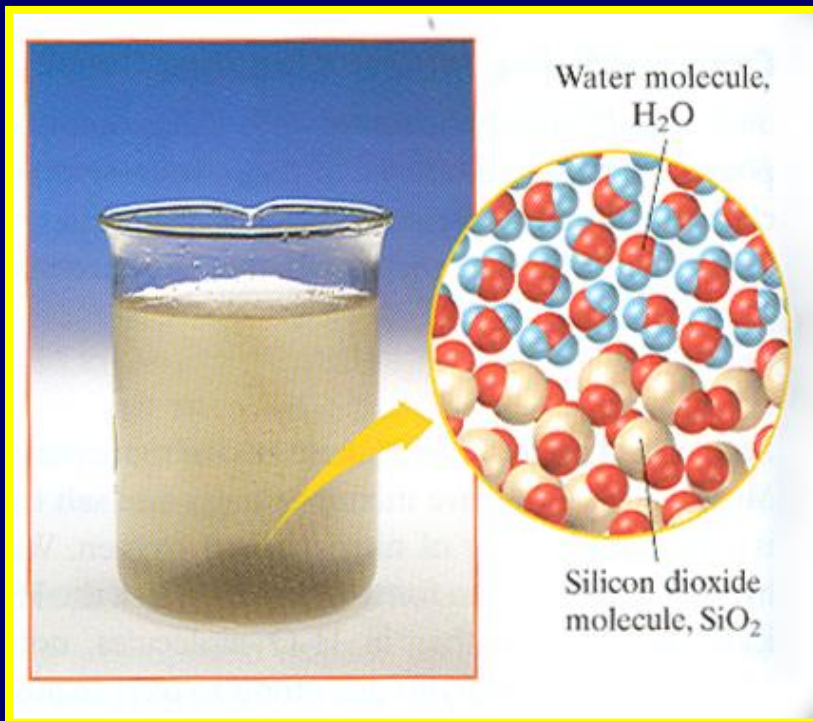
Brass is an alloy made from copper, zinc, and a small amount of lead. It was originally used for coins, buttons, and lamps.





# Heterogeneous Mixture

Heterogeneous Mixtures are those in which the individual substances can be visibly distinguished from each other.



**Sandy Water**

**Orange Juice**

**Salad**

**Pizza**

# The End

