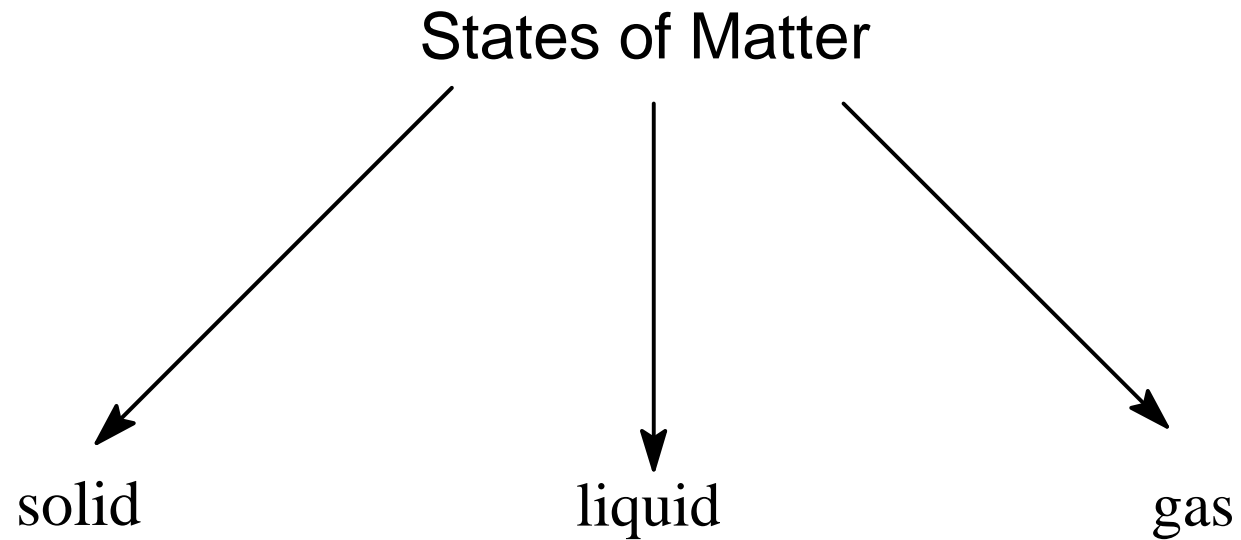
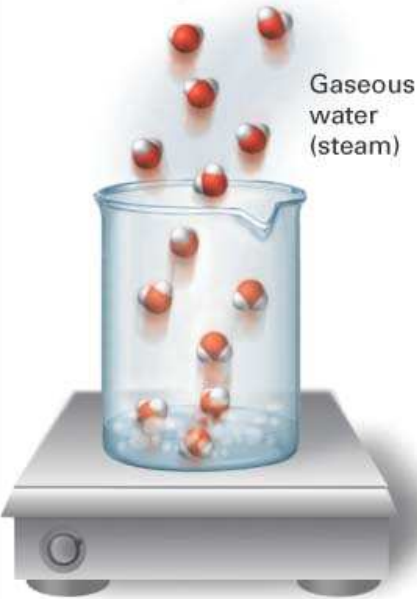




Matter and Energy



Properties of States

| | Gas | Liquid | Solid |
|-----------------------------|---|---|--|
| Water as an example: |  <p>Gaseous water (steam)</p> |  <p>Liquid water</p> |  <p>Solid water (ice)</p> |
| Shape | Variable—same as a closed container | Variable—same as the bottom of the container | Constant—rigid, fixed |
| Volume | Variable—same as a closed container | Constant | Constant |
| Particle Movement | Completely independent (random); each particle may go anywhere in a closed container | Independent beneath the surface, limited to the volume of the liquid and the shape of the bottom of the container | Vibration in fixed position |

Chemical and Physical Changes, Properties, and Processes

a change that does not change the composition of the substance is called a physical change

ice and liquid water are the same substance (H_2O)

Chemical Changes

Changes (forever) the composition of the substance

Chemical or Physical?

elasticity of a rubber band ?

an iron nail rusting?

burning wood?

frying an egg?

boiling water?

Characterizing Matter

Matter

heterogeneous

homogeneous

heterogeneous

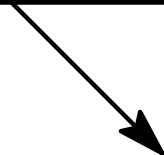
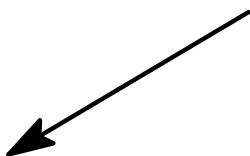
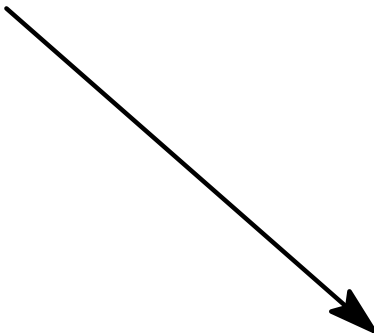
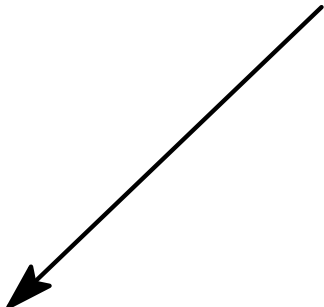
homogeneous

mixture

pure
substance

elements

compounds



Elements

Names

Symbols

oxygen

O

chlorine

Cl

iron

Fe

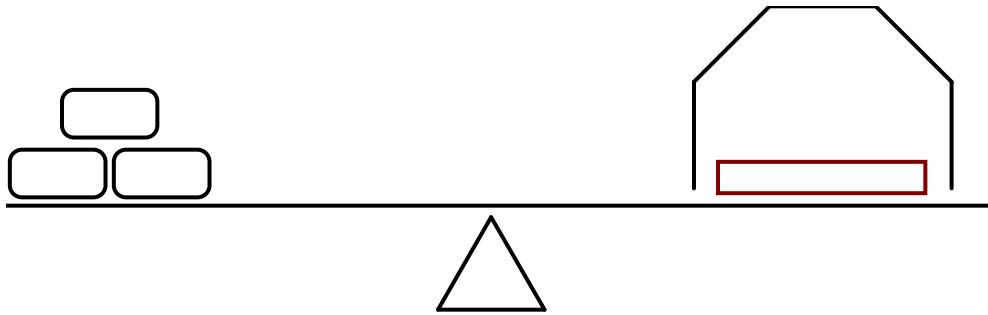
Compounds

| Names | Symbols |
|-----------------|-------------------|
| carbon monoxide | CO |
| sodium chloride | NaCl |
| zinc bromide | ZnBr ₂ |

Conservation Laws

Law of Conservation of Matter

**Matter cannot be created or destroyed
when a chemical reaction occurs**



Conservation of Energy

Energy cannot be created or destroyed

examples:

slowing a moving car with the brakes

using generated electricity by a powerplant

The Atomic Age



$$E=mc^2$$

During the process of a nuclear reaction the mass of the products is less than the mass of reactants. The mass is converted into energy by the Einstein equation.

Energy Changes

A process that absorbs energy
is said to be **endothermic**

A process that releases energy
is said to be **exothermic**

water freezing?

alcohol boiling?

remember:

solid $\xrightarrow{\text{add energy}}$ liquid $\xrightarrow{\text{add energy}}$ gas