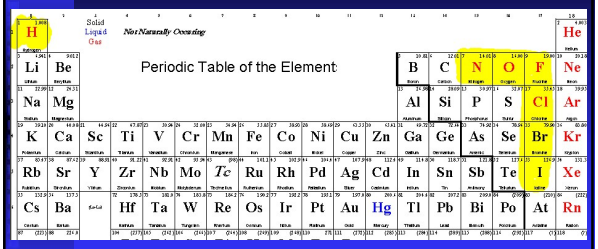
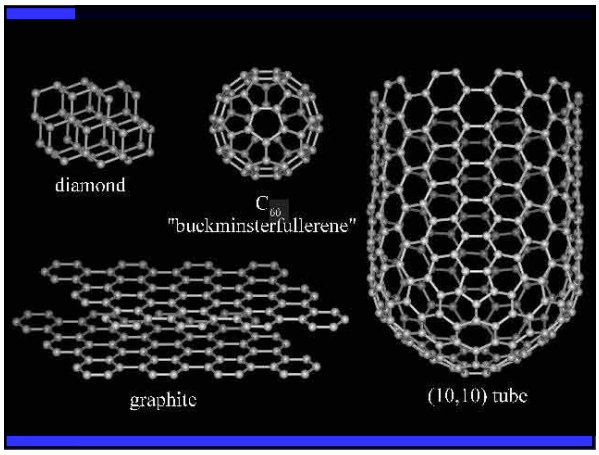
Some elements can have molecules as their smallest component

- as long as the molecule is made up entirely of the same atom
- The oxygen we breathe is not 1 oxygen atom, it is O_2
- When 2 atoms are joined like in the above case, it is called a diatomic element
- The 7 diatomic elements are hydrogen, nitrogen, oxygen, fluorine, chlorine, bromine, and iodine



Allotropes

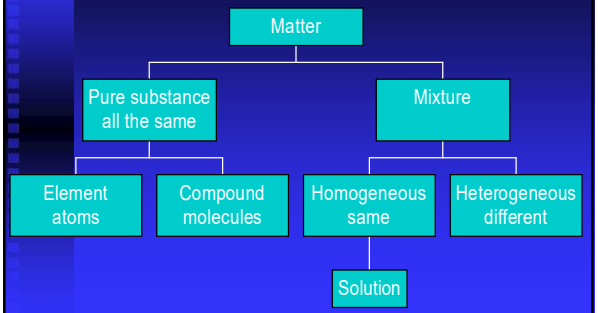
- allotrope -one of the different molecular forms of an element
- oxygen has 2 allotropes
- O_2 and O_3 (ozone)
- carbon has several allotropes
- graphite, diamond, buckyball (found in soot)



Mixtures

- compounds and/or elements mixed together but not bonded together
- heterogeneous mixture- different throughout or chunky
- granite, orange juice with pulp, Italian dressing
- homogeneous mixture- even throughout
- milk and saltwater
- Solution really well mixed homogeneous mixtures

Breakdown of classification



Separating Mixtures

- Mixtures can be separated by chemical or physical means

Separating Compounds

- compounds can ONLY be separated by chemical means (requires a chemical change)

Separating Elements

- atom is from the Greek word atomos, meaning not able to be cut.
- elements can NOT be separated by chemical or physical means.
- The only way to separate an atom is through a nuclear reaction.

Energy

and Chemistry

Law of conservation of energy

- Energy can neither be created nor destroyed, it can only change forms.
- An exothermic reaction releases energy, where did it come from?
- The energy holding the molecules of the reactants together (bonds). The products need less energy to be held together so the energy is released to the area surrounding the reaction.

Endothermic reactions absorb energy, where does that come from?

- ~from the area surrounding the reaction.
- That is why it ends up feeling colder.
- In both cases energy is conserved, it is either donated to another system or taken from another system.

Energy Changes

- All chemical reactions (chemical changes) involve a change in energy
- Physical changes also involve a change in energy
- We are only going to look at phase changes

Heat energy

- Atoms/molecules in a substance are not stationary, they move around.
- Heat energy in an object is the rate of motion of atoms/molecules in a substance
- The faster the particles are moving the more heat energy the substance has.

Energy in phases

- Solid- atoms/molecules vibrate in one place, occasionally sliding by one another.
  ~students in detention
- Liquid- atoms/molecules move freely with more energy within a confined volume.
  ~students in the cafeteria
- Gas- atoms/molecules move around wildly constantly running into each other.
  ~football practice

Causing phase changes

- To go from solid → liquid→ gas you…
- add energy (from another system)
- to turn ice into water you heat it, to turn water to steam you heat it.
- To go in the reverse direction you ***remove*** energy. (there is no cold energy you can add)

Matter without heat energy

- If you continually cool (remove energy) an object, eventually the object will have no more energy.
- This is called ***absolute zero***. It is when all motion (of the particles) stops.
- It should occur at -273.15° C or 0 K or -459° F
- Cornell and Wieman cooled a sample to 0.000000004 K

Temperature

- A measure of intensity of the heat energy in an object.
- It is an average of how fast the particles are moving within an object.
- It is measured in Celsius (centigrade) or Kelvin scale.
- Kelvin = Celsius + 273

Matter and energy connection

- matter can be converted into energy.
- you can calculate by the equation:
- $E = mc^2$
- energy = mass x (speed of light)^2
- speed of light = 3.0 x10^8 m/s
- This is in Einstein's theory of special relativity.
- This happens in all energy transfers but normally the difference is too small to measure