

The background of the slide features a collection of chemistry glassware. There are several Erlenmeyer flasks containing liquids of different colors: yellow, orange, and blue. A glass dropper is positioned over one of the flasks, with a small red exclamation mark placed directly above its tip. The entire scene is set against a light, textured background.

Matter

The Puzzle of Matter

The Particulate Nature of Matter

- **What is Matter?**

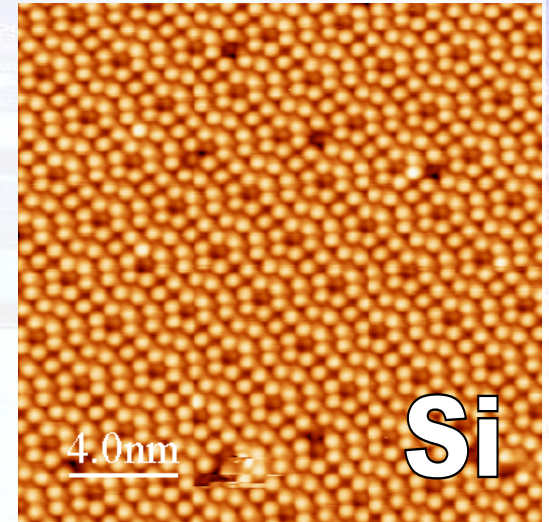
- **Matter** → the “stuff” that the universe is composed of.
- Has mass and occupies space.
- Examples include: stars, air, gasoline, chair, cells, etc...
- Matter is very diverse.
- All matter is composed of a small number of fundamental particles.



The Particulate Nature of Matter

The Atomic Nature of Matter

- Atoms are too small to be seen with the naked eye, so how do we know they exist?
 - In recent years, scientists developed a scanning tunneling microscope (STM) that can produce images of atoms.



The Particulate Nature of Matter

- When chemists look at metals and other substances under really powerful microscopes, they are able to see the atoms.

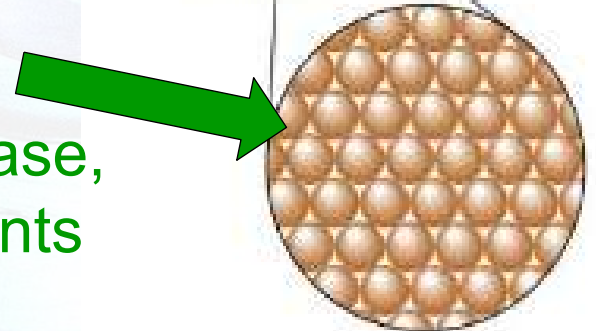
Macroscopic

You can see with your naked eye!



Microscopic

You need a microscope to see. In this case, you need a STM! It shows the components that make up what you are able to see.



Like the bricks in a building, only much smaller!

The Particulate Nature of Matter

- With ultra-high magnification, objects appear more similar.
- This is because all objects are made up of small particles called atoms.
- Atoms are so tiny that you need a powerful magnifying instrument to see them.
- It is like how sand looks uniform from a distance.



The Particulate Nature of Matter

Beach at
Cabasson
(Baigne-cul)

Henri-Edmond
Cross



- Although objects in the macroscopic world look continuous and uniform, they are really made of atoms (particulate)!

Elements and Compounds



- **What are Atoms?**

- **Atoms** → fundamental unit of which elements are made.
 - Not all atoms are alike.
 - Copper atoms are different from oxygen atoms, which are different from hydrogen atoms.
- All the matter in the universe is constructed by putting about 100 types of atoms together in different ways!

Elements and Compounds

- We call the 100+ types of atoms the *elements* of the universe.

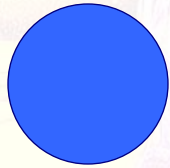
Top Ten Elements in the Universe

| Element | Percent (by atoms) | | Element | Percent (by atoms) |
|----------|-----------------------|--|-----------|-----------------------|
| Hydrogen | 73.9 | | Iron | 0.11 |
| Helium | 24.0 | | Nitrogen | 0.097 |
| Oxygen | 1.1 | | Silicon | 0.065 |
| Carbon | 0.46 | | Magnesium | 0.058 |
| Neon | 0.13 | | Sulfur | 0.044 |

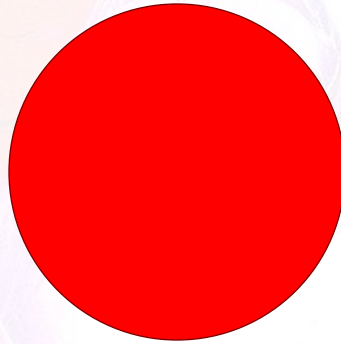
Elements and Compounds

Compounds

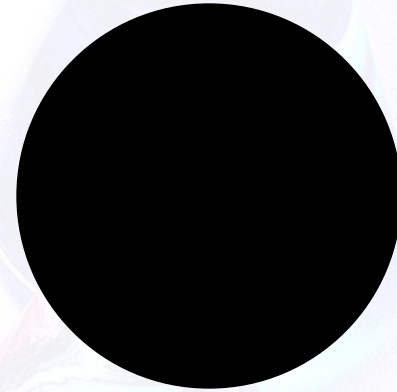
- Atoms are often drawn or represented as spheres.



1 Hydrogen
Atom



1 Oxygen
Atom

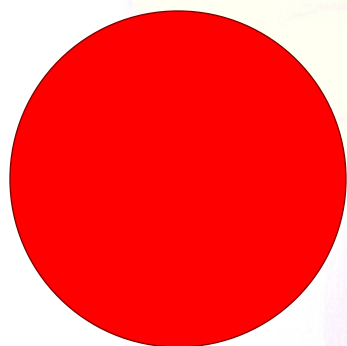


1 Carbon
Atom

- We can combine the atoms in a variety of ways to form compounds.

Elements and Compounds

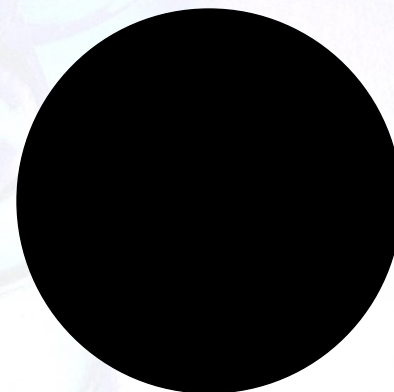
- **Compounds** → substances made by bonding atoms together in specific ways.
 - Contains 2 or more different types of atoms bound together in a particular way.
 - Specific compound consists of the same particle throughout.



1 Oxygen
Atom

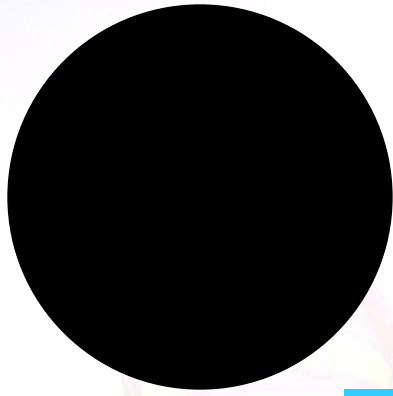
Carbon Monoxide

poisonous gas



1 Carbon
Atom

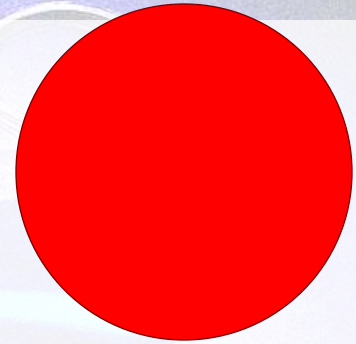
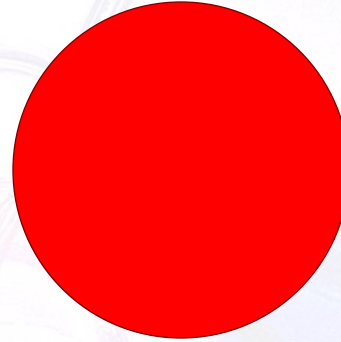
Elements and Compounds



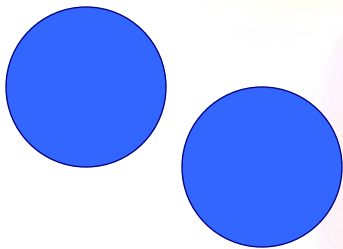
1 Carbon
Atom

Carbon Dioxide

you breathe out, plants use



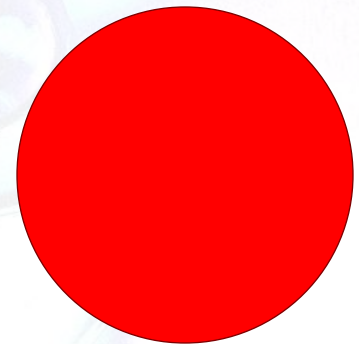
2 Oxygen
Atoms



2 Hydrogen
Atoms

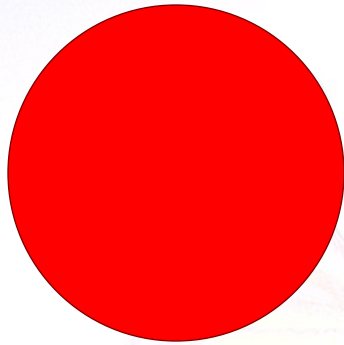
Water

most important liquid on Earth

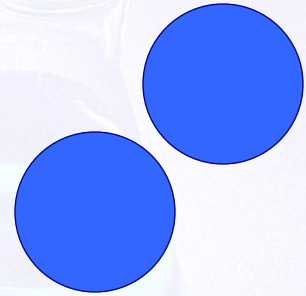
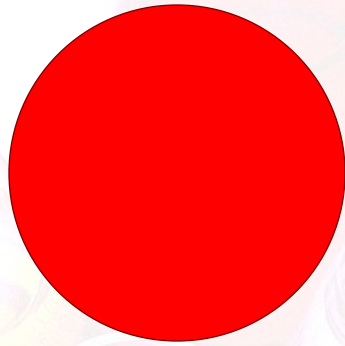


1 Oxygen
Atom

Elements and Compounds



2 Oxygen
Atoms

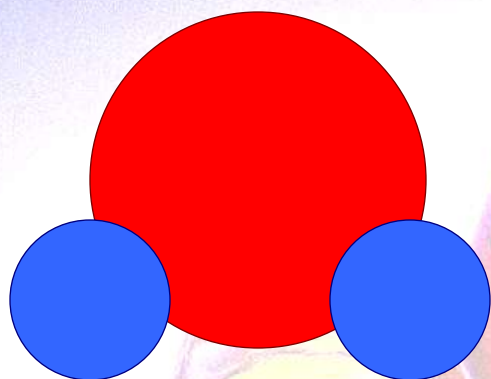


2 Hydrogen
Atoms

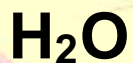
Hydrogen Peroxide

used to disinfect cuts and bleach
teeth and hair.

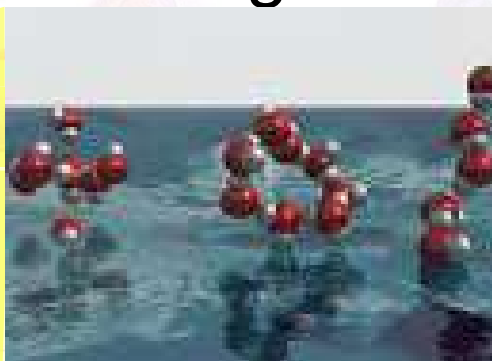
Elements and Compounds



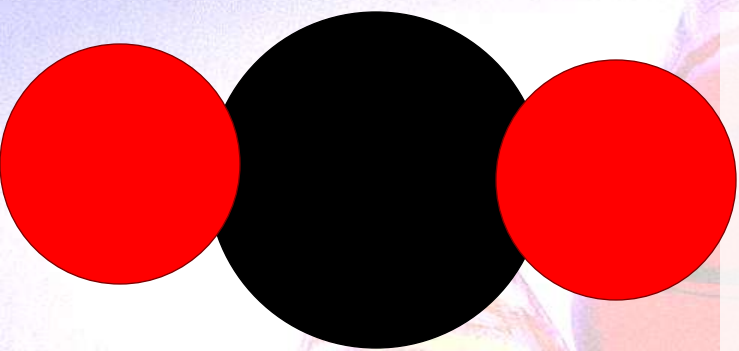
1 Water
Molecule



- In a glass of water, the particles consist of 2 hydrogen atoms bonded to an oxygen atom.
- **Molecule** → made up of atoms that are “stuck” together (behave as a unit).
 - A glass of water contains a huge number of molecules packed closely together.



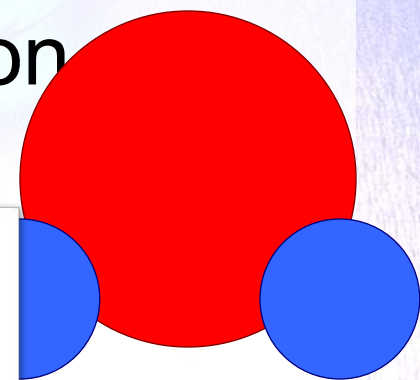
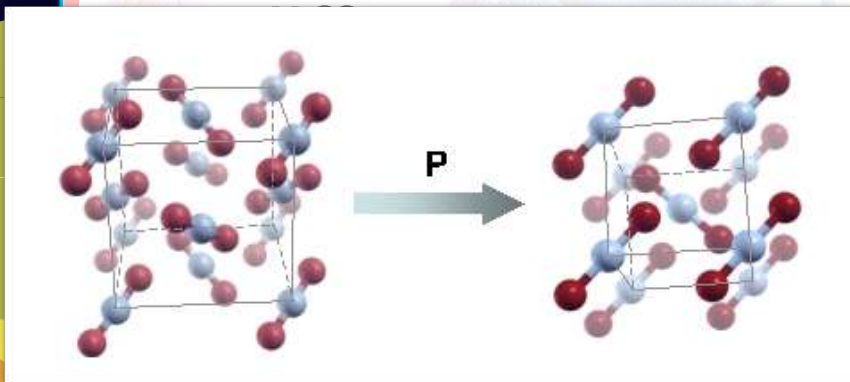
Elements and Compounds



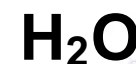
1 Carbon Dioxide
Molecule



- Dry ice is solid carbon dioxide and contains many CO_2 molecules packed together.
- Notice that all the molecules in dry ice are the same.
 - Water and carbon dioxide are



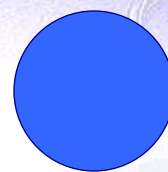
1 Water
Molecule



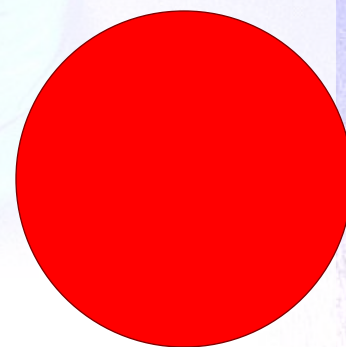
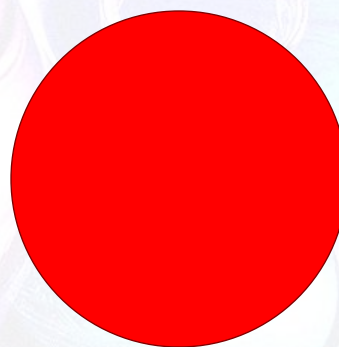
Elements and Compounds

Elements

- Atoms of the same type can also combine to form molecules.
- Since pure hydrogen and oxygen each contain only one type of atom, they are called elemental substances.



1 Hydrogen
Molecule

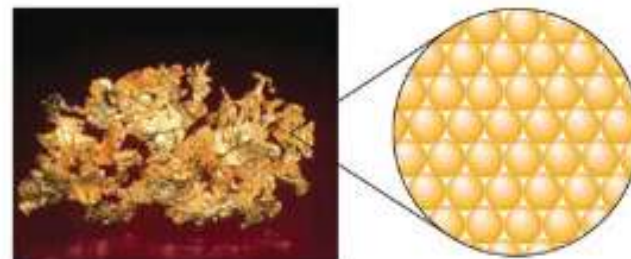


1 Oxygen
Molecule

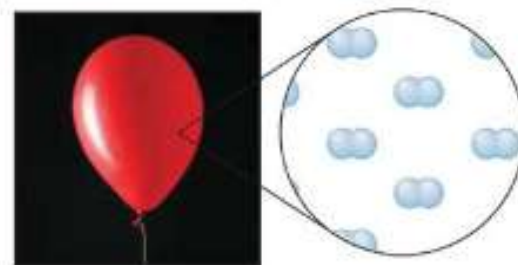


Elements and Compounds

- **Elements** → substances containing only one type of atom.
 - Examples include:
 - Pure gold contains only gold atoms.
 - Elemental copper contains only copper atoms.
 - Hydrogen gas contains only hydrogen atoms.
 - Any pure sample of an element contains only atoms of that element, *never* any atoms of any other element.



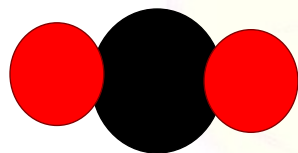
Gold Atom



H₂ molecule

Elements and Compounds

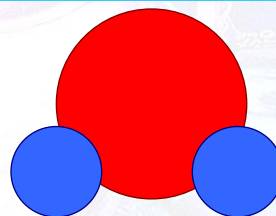
- A **compound** always contains atoms of different elements.
- A compound also always has the same composition (combination of atoms).



1C:2O

Carbon Dioxide

CO₂ O-C-O



1O:2H

Water

H₂O H-O-H

- The properties of a compound are very different from those of the elements it contains.

Elements and Compounds

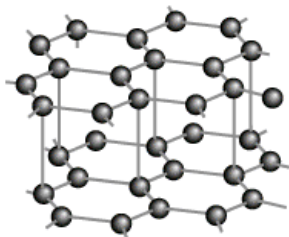
Chemistry in Your World:

Carbon (C) – Element of Many Forms

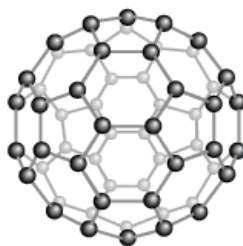
- Three forms of elemental carbon:
 - **Graphite** makes up pencil lead.
 - **Diamond** is a brilliant, hard gemstone.
 - **Buckminsterfullerene** is a C_{60} molecule that resembles a soccer ball.



Diamond



Graphite



Buckminsterfullerene

A collection of laboratory glassware is arranged on a light blue surface. There are five Erlenmeyer flasks: one in the top center containing a pink liquid, one to the left containing a yellow liquid, one in the bottom left containing an orange liquid, one to the right containing a blue liquid, and one in the bottom right containing a green liquid. A glass dropper with a blue stopper is positioned in the center, partially submerged in the pink liquid. The text "The End!" is overlaid in the center in a large, bold, red font.

The End!