



## **Atoms and Molecules**

Unit 3 Lesson 1

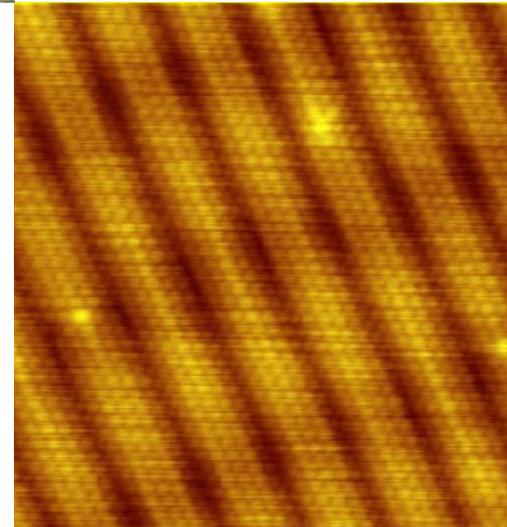
## What is an Atom?

- **Atoms** are the simplest building block of **matter** – both living and nonliving.
- Originally, it was thought that atoms were indivisible.



*The Greek philosopher Democritus introduced the idea of the atom around 450BC.*

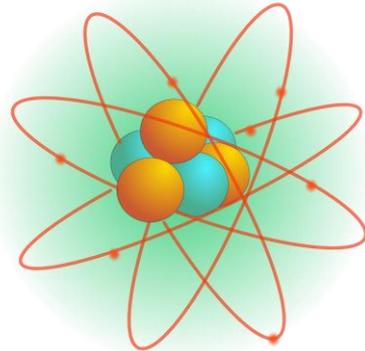
*Scanning tunneling microscope image of the atoms in a gold surface.*



## What is an Atom?

- However, we now know that an atom can be broken down further, although its chemical properties are not retained.
- Therefore, an atom can be defined as:

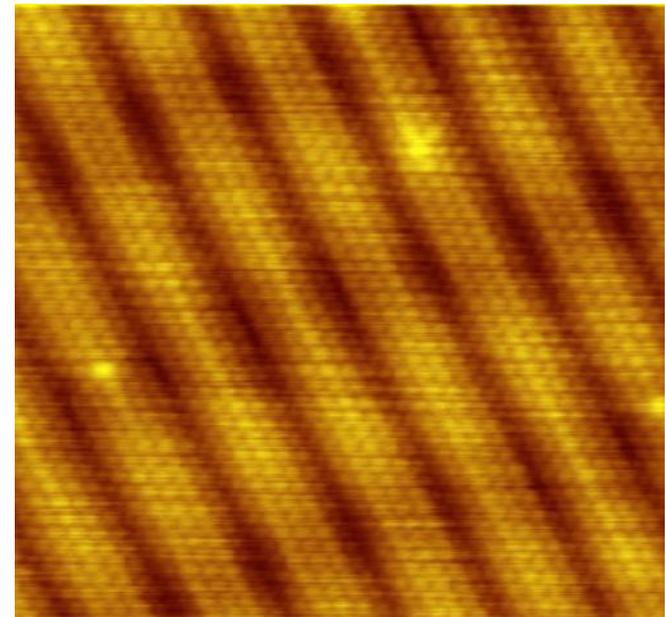
*“The smallest particle of a given **element** that retains the elements chemical properties.”*



## What is an Atom?

For example,

- A gold coin is made up of many **gold** atoms molded into the shape of a coin, the coin also has small amounts of other elements.
- Gold atoms cannot be broken down into anything smaller and still retain the **properties** of gold.
- A gold atom gets its properties from the tiny subatomic particles from which it is made.



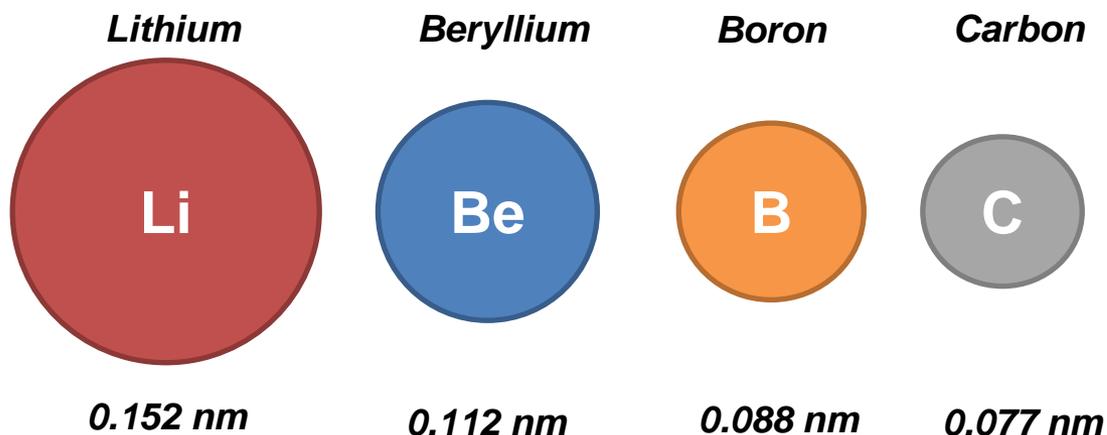
## How big are Atoms?

- Atoms are tiny, measuring  $10^{-10}$  meters in size.
- They are so small in fact, that when stacked, it would require millions of them to make a layer as thick as a sheet of paper.
- The table below shows the relative sizes of the radius of some everyday objects compared to the radius of the smallest atom - hydrogen:

Radius (m)	Object
$10^{-10}$	An atom of hydrogen
$10^{-4}$	A grain of sand
$10^{-1}$	Watermelon
$0.2 \times 10^{-1}$	Cricket ball

## The Basic Structure of the Atom

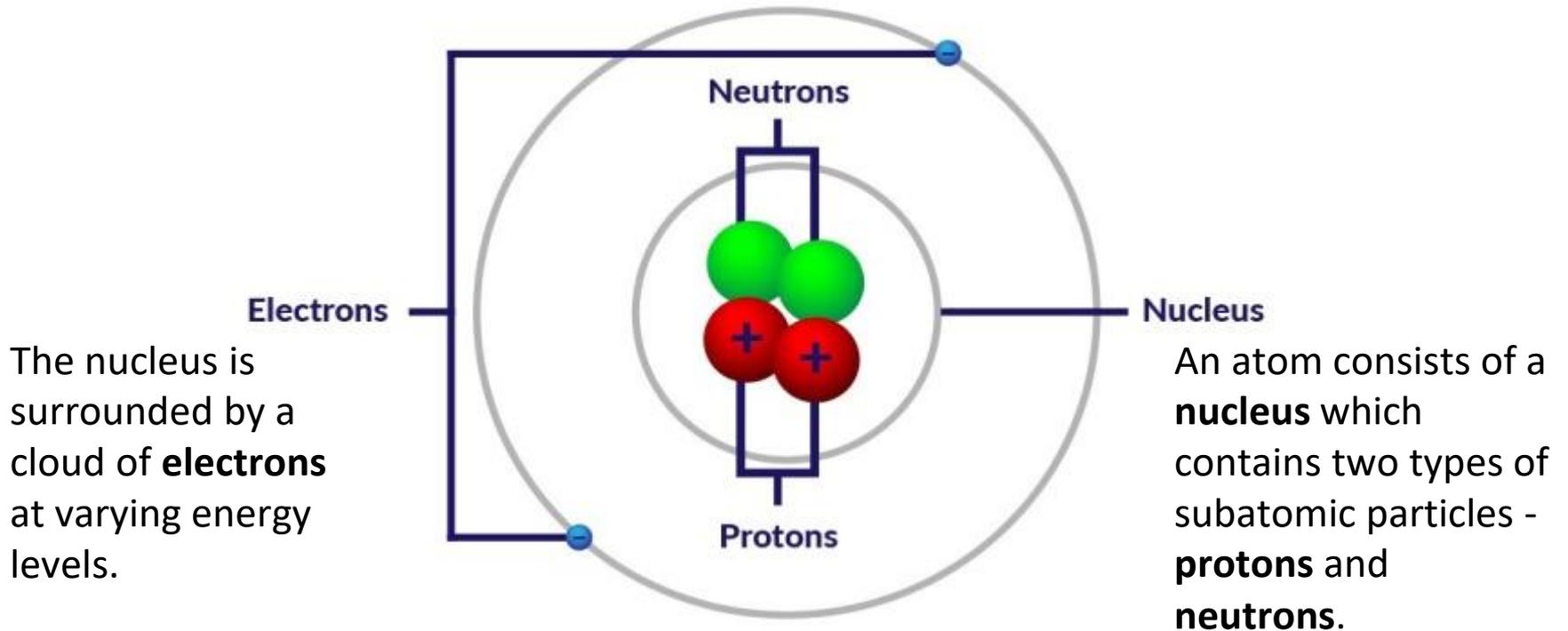
- The atoms of different elements can vary in **size** and **mass**, due to the number of subatomic particles they have in their nucleus and the number of **electron shells** they possess.



*The atomic radii of the first four elements of row 2 of the Periodic Table*

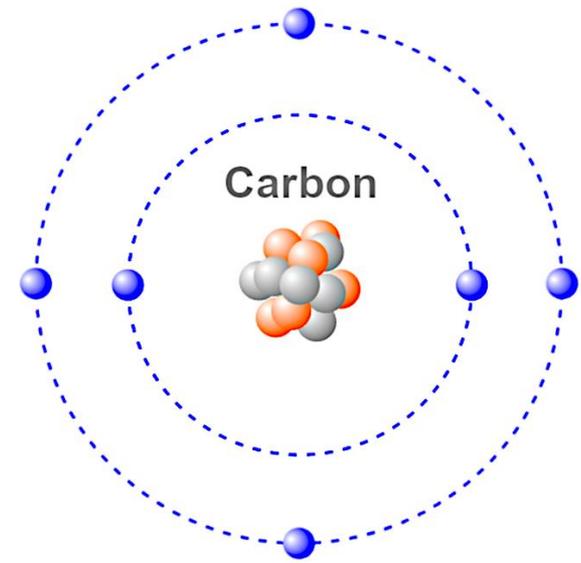
## The Basic Structure of the Atom

- There are three main particles that you will need to be able to identify:



## Charged Particles

- Protons and electrons are **oppositely** charged and are therefore attracted to one another.
- This holds the atom together and gives it an overall (**net**) charge of zero, since these charges cancel each other out.



*An atom of carbon has the same number of protons and electrons.*

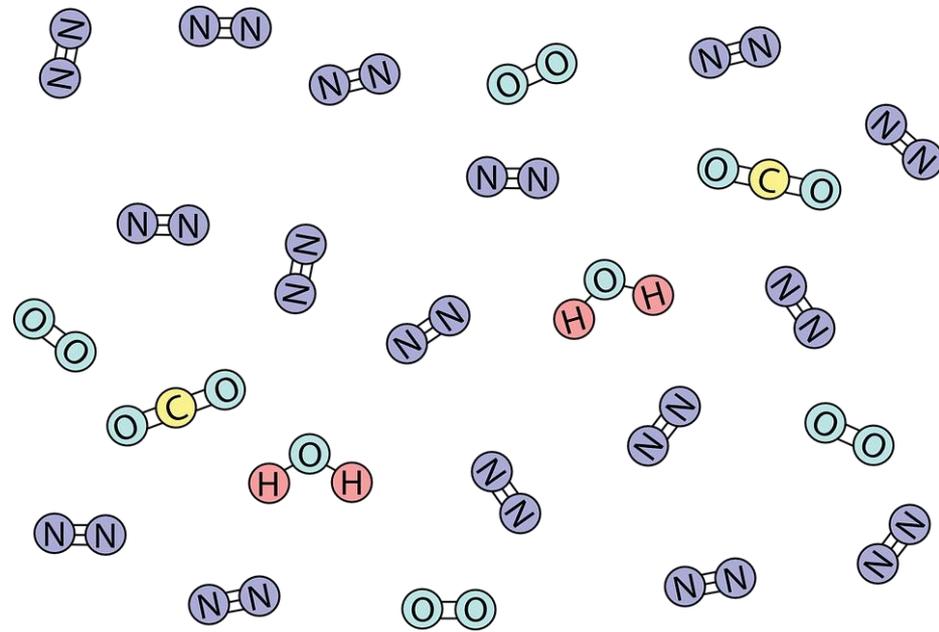
## Charged Particles

The table below shows the charge and relative mass of each of the three particles found in the atom (the neutron is used as a point of comparison to find the relative mass of protons and electrons).

	Charge	Relative Mass
Proton	Positive	0.9986
Neutron	No charge (neutral)	1
Electron	Negative	0.0005439

## What are molecules?

- Many atoms cannot exist singularly and will, therefore, react with one another to form **molecules**.
- A molecule is defined as:  
*“a collection of **two** or **more** atoms of the same or different element in a definite arrangement.”*

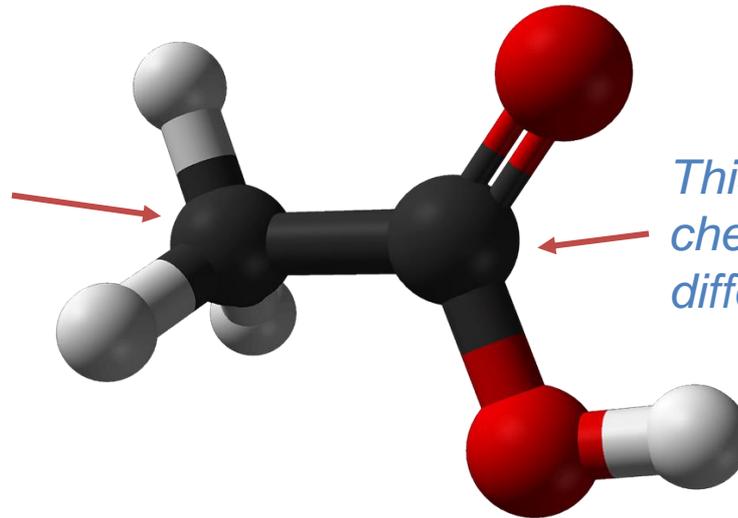


*The gas molecules found  
in Earth's atmosphere*

## What are molecules?

- The atoms in a molecule are held together by **chemical bonds** which can only be broken when a chemical reaction takes place.

*This carbon atom  
chemically bonded to  
three hydrogen atoms*



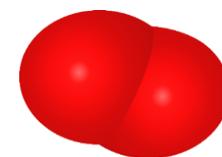
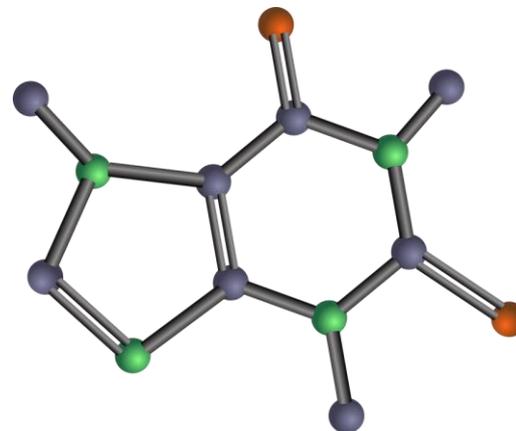
*This carbon atom  
chemically bonded to two  
different oxygen atoms*

*The molecular structure for a molecule of acetic acid (vinegar)*

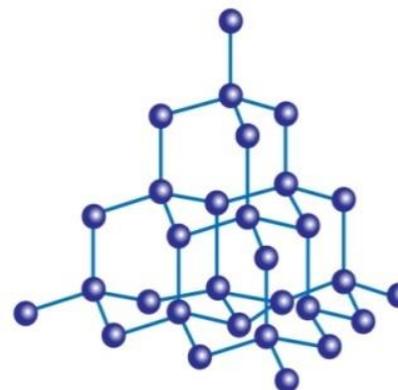
## What are molecules?

- Molecules can be simple, consisting of only a few atoms or complex containing thousands of atoms.
  - For example, the simple molecule **oxygen** is a gas found in the air we breathe. It consists of two oxygen molecules chemically bonded together (**O<sub>2</sub>**).
  - By contrast, a 0.2g **diamond** gemstone contains **10<sup>22</sup>** carbon atoms.

*Caffeine molecule*



*An oxygen molecule*



*Diamond*



*Brilliant cut diamonds*