

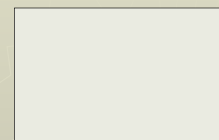
# Atoms Foldable

Featuring:

Protons, Neutrons, & Electrons

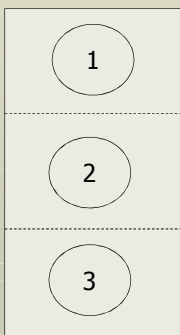
First, fold your paper in half like this.

Not this.



You need three "flaps."

To cut "flaps," cut only the top half of the folded paper.



**Do not write these numbers on your flaps!**

What happens if the number of protons in an atom changes?

What happens if the number of neutrons in an atom changes?

What happens if the number of electrons in an atom changes?

①  
②  
③

**Protons** – The positively charged particle located in the nucleus

Mass of 1 Proton = 1 amu (atomic mass unit.)  
Mass of 1 Proton =  $1.6726 \times 10^{-24}$  g

①  
②  
③

**The # of Protons**

- Identifies the element
- It is the atomic number.
- If it changes, then the identity of the element changes.
- The periodic table is listed according to the number of protons.

**Atomic Number** –  
It's always a whole number.

1  
H  
1.0008

①  
②  
③

6  
H  
12.011

**# Neutrons**  
Rounded mass – atomic number

**Neutrons** – The neutral particle located in the nucleus.

Mass of 1 Neutron = 1 amu (atomic mass unit.)  
Mass of 1 Neutron =  $1.6749 \times 10^{-24}$  g

The mass of 1 proton and 1 neutron are essentially equal.

①  
②  
③

**The # of Neutrons**

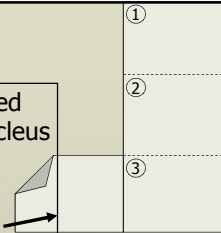
- When the number of neutrons changes, the number of protons stays the same. The identity of the *atom does not change*. It simply changes the mass of the atom.
- Atoms of the same element with different numbers of neutrons are called **isotopes**.
- All isotopes of an atom have the *same chemical properties*, but MAY have *different physical properties*.

**Electrons** – The negatively charged particles that travel around the nucleus in orbitals collectively called the electron cloud.

Mass of 1 Electron =  $9.0193 \times 10^{-28}$  g

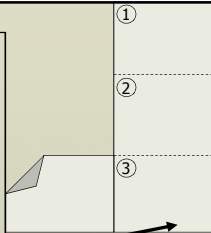
Electrons mass is approx. 2000 times less than a proton or neutron.

We consider electrons massless.



**The # of Electrons**

- ▶ In neutral atoms, the number of protons is equal to the number of electrons.
- ▶ If the number of electrons changes, then the atom is no longer electrically neutral.
- ▶ If an atom loses electrons, it is positively charged and is called a cation.  $\text{Na}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Al}^{3+}$
- ▶ If the atom gains electrons, it is negatively charged and is called an anion.  $\text{Cl}^-$ ,  $\text{O}^{2-}$ ,  $\text{N}^{3-}$

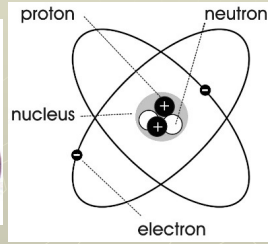


**In Summary:**

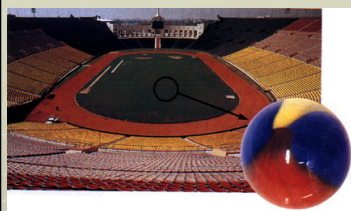
- ▶ All of the mass of an atom is concentrated in the nucleus. (Protons & Neutrons)
- ▶ All of the volume of an atom is taken up by the electron cloud (mostly empty space.)
- ▶ Neutral atoms have the same # $p^+$  as # $e^-$
- ▶ Atoms of the same element can have varying masses

**In Summary:**

Protons + neutrons make up the tiny dense nucleus, electrons make up the majority of the volume.



**For Scale:** If an atom was the size of a football field, the nucleus would be a marble on the 50 yard line.



### In Summary:

- ▶ Remember that electrons do not follow fixed paths (Bohr), but move freely and randomly within certain energy levels (de Broglie).

