

Target: I can describe
advancements in the model
of the atom, and can count
subatomic particles

**ATOMIC #'S AND
ISOTOPES**

N5



John Dalton

DALTON'S ATOMIC THEORY (1808)

- 1) All matter composed of extremely small particles called atoms**





John Dalton

DALTON'S ATOMIC THEORY (1808)

- 2) **Atoms of a given element are identical in size, mass, and other properties**





John Dalton

DALTON'S ATOMIC THEORY (1808)

- 3) **Atoms of different elements differ in size, mass, and other properties**





John Dalton

DALTON'S ATOMIC THEORY (1808)

- 4) Atoms cannot be subdivided, created, or destroyed**





John Dalton

DALTON'S ATOMIC THEORY (1808)

- 5) Atoms of different elements combine in simple whole-number ratios to form chemical compounds**





John Dalton

DALTON'S ATOMIC THEORY (1808)

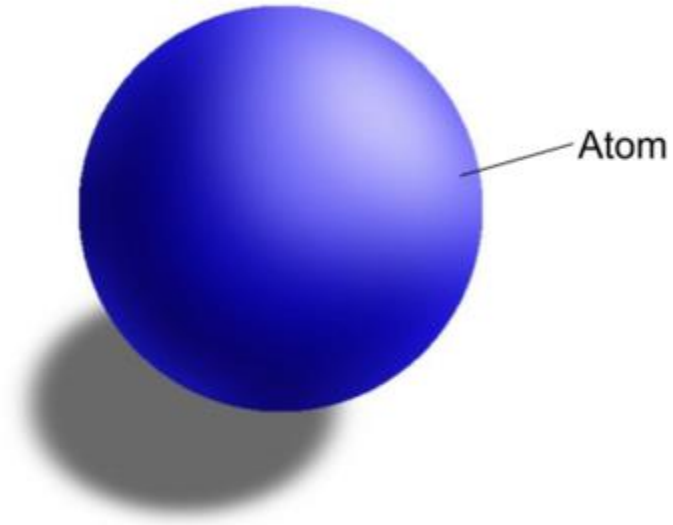
- 6) In chemical reactions, atoms are combined, separated, or rearranged**



DALTON'S BILLIARD BALL MODEL



John Dalton



MODERN ATOMIC THEORY – WHAT WAS WRONG WITH DALTON'S THEORY?

**Atoms have an
AVERAGE MASS!**



**It is an AVERAGE
because of ISOTOPES!**

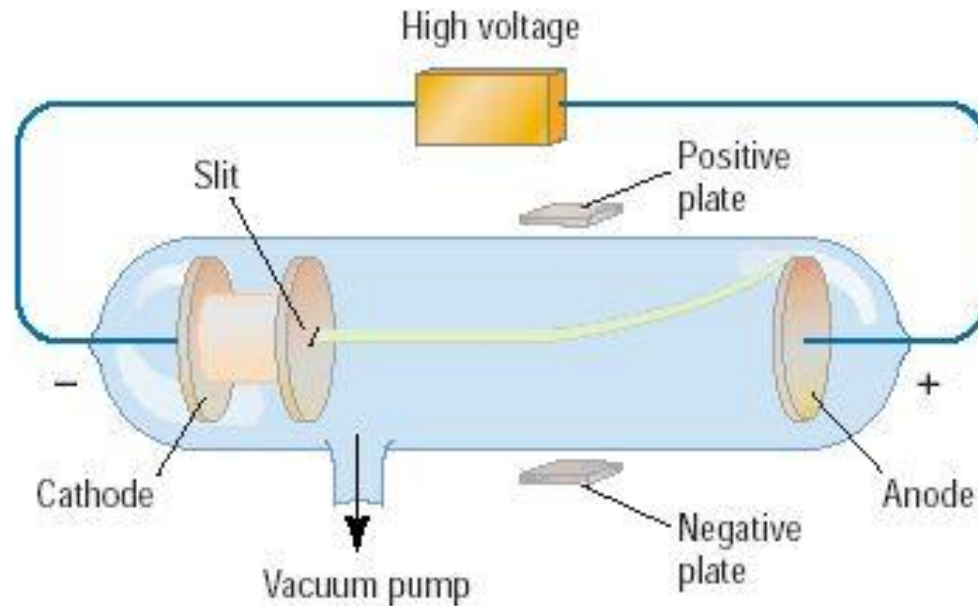
**Atoms cannot be
divided, created
or destroyed
during NORMAL
chemical reactions**



**BUT they CAN do
those things during
NUCLEAR reactions!**

DISCOVERY OF THE ELECTRON

In 1897, J.J. Thomson used a cathode ray tube to deduce the presence of a negatively charged particle.



Cathode ray tubes pass electricity through a gas that is contained at a very low pressure.

<https://www.youtube.com/watch?v=O9Goyscbazk>

CONCLUSIONS FROM THE STUDY OF THE ELECTRON

Cathode rays have identical properties regardless of element used



All elements must contain identically charged electrons.

Atoms are neutral



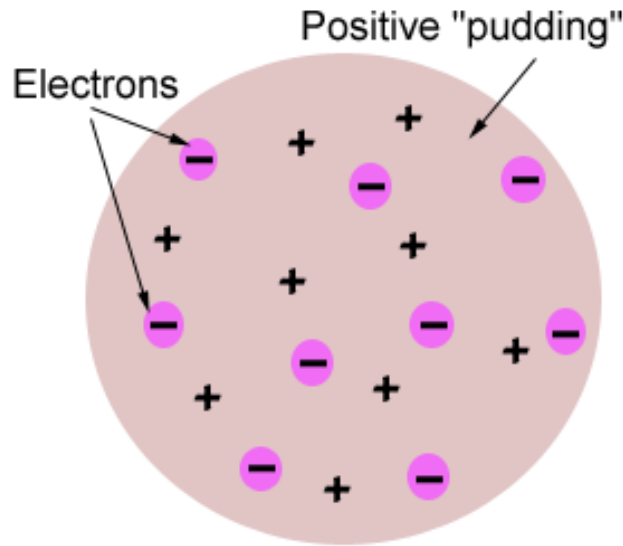
Must be positive particles balancing the negative charge of electrons

Electrons have very little mass compared to the atom's mass



Atoms must contain other heavier particles that account for most of the mass

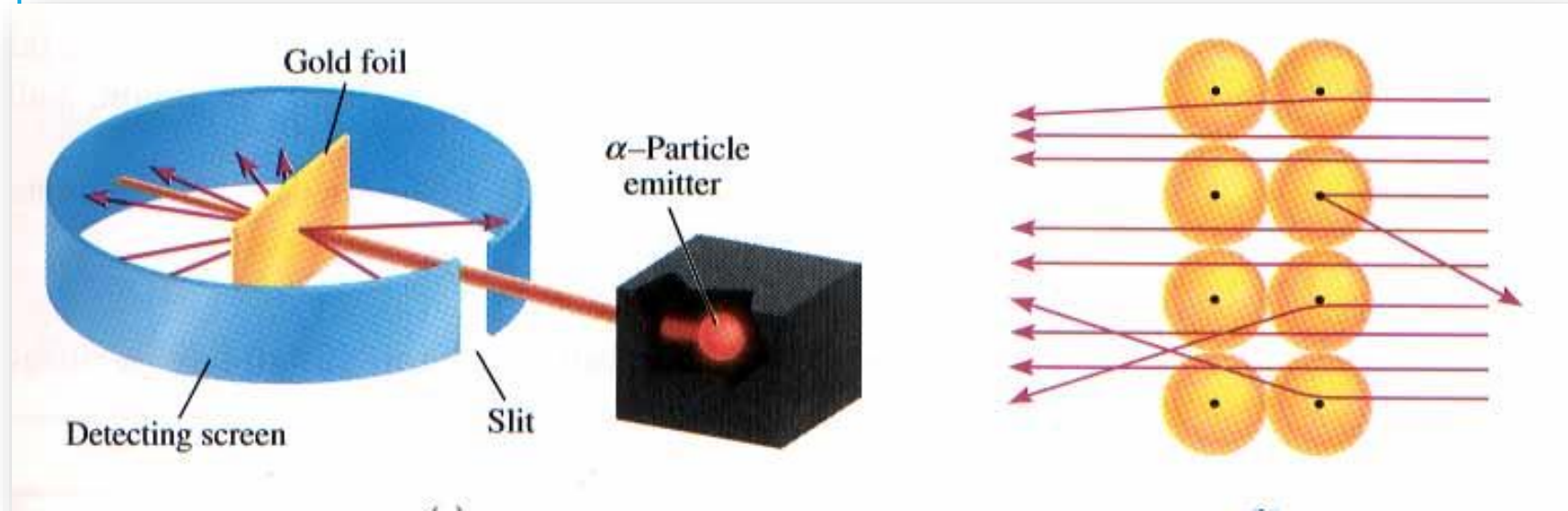
THOMSON'S ATOMIC MODEL



Thomson believed that the electrons were like plums embedded in a positively charged “pudding,” thus it was called the “plum pudding” model. We don’t usually eat plum pudding in this country, so I like to call it the chocolate chip cookie model.

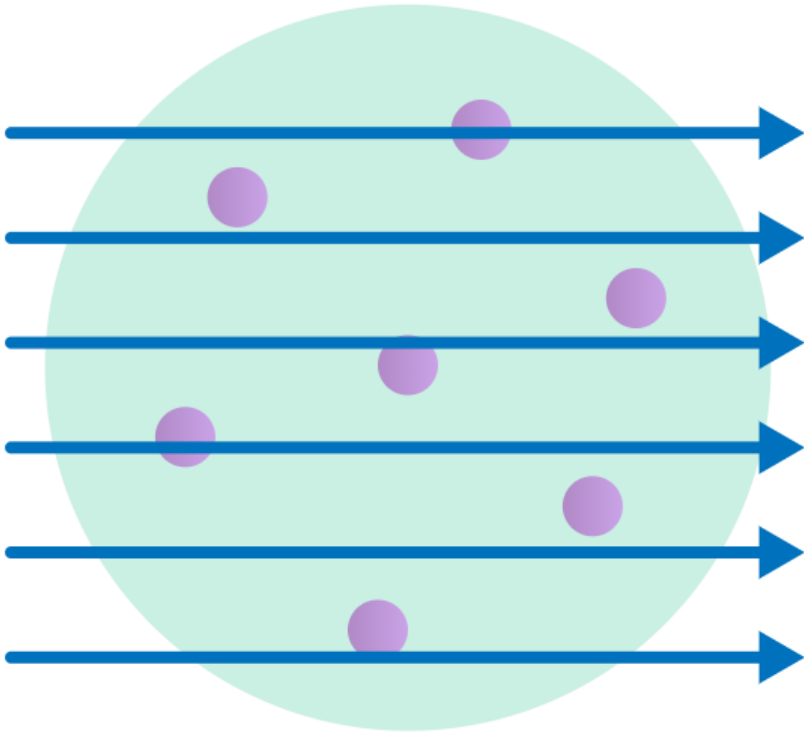


RUTHERFORD'S GOLD FOIL EXPERIMENT

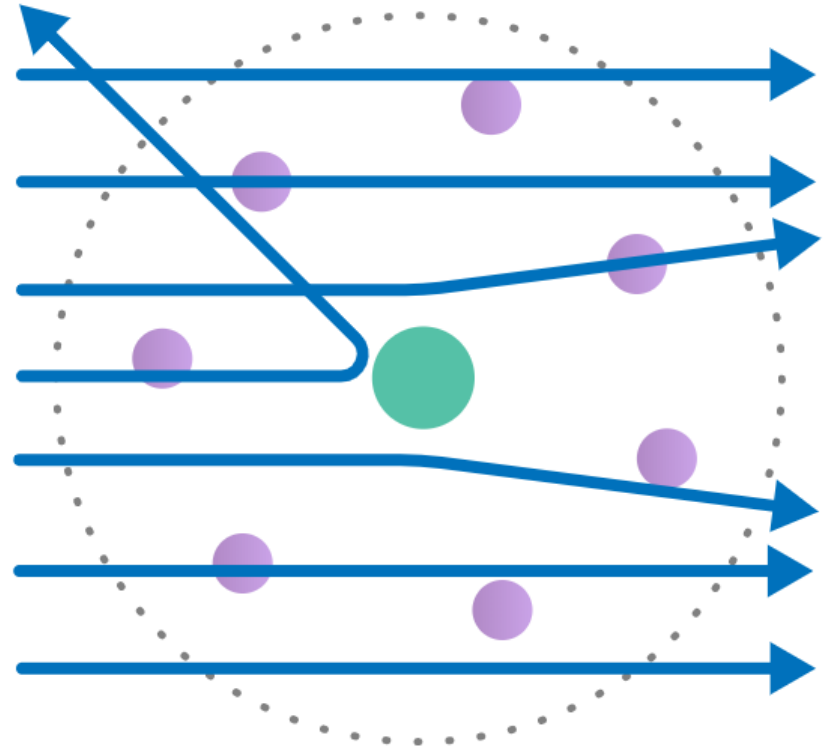


- Alpha (α) particles are helium nuclei
- Particles were fired at a thin sheet of gold foil
- Particle hits on the detecting screen (film) are recorded

THOMSON MODEL



RUTHERFORD MODEL



<https://www.youtube.com/watch?v=XBqHkraf8iE>

RUTHERFORD'S FINDINGS

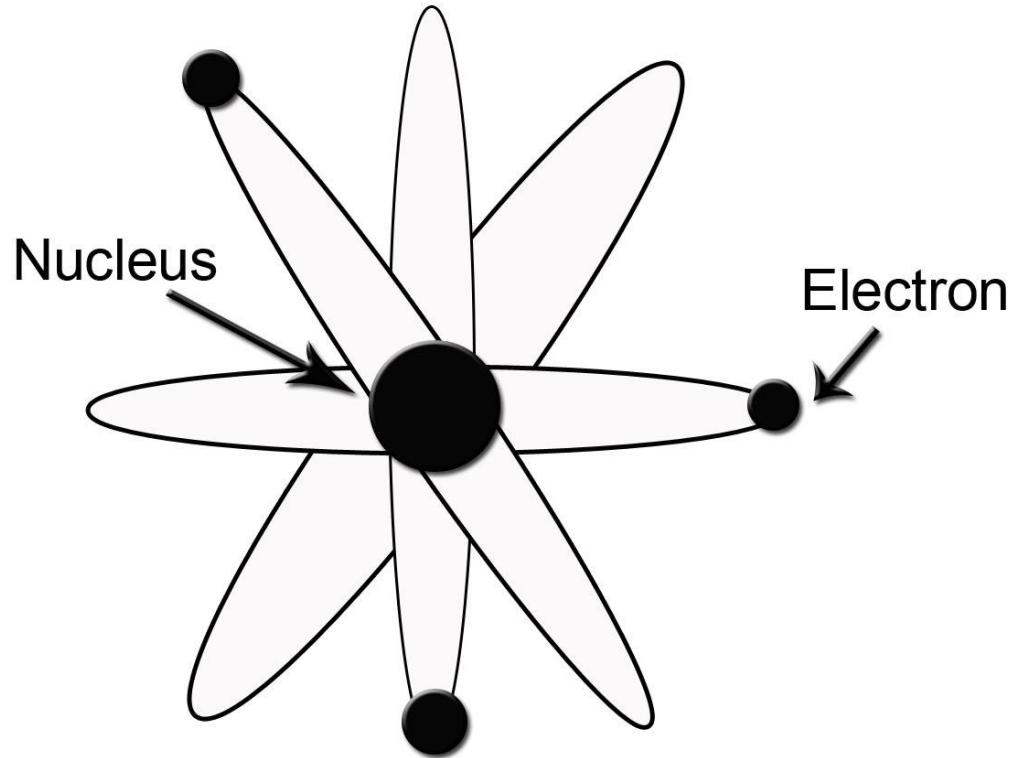
- 1) Most of the particles passed right through
- 2) A few particles were deflected
- 3) A FEW were greatly deflected

CONCLUSIONS:

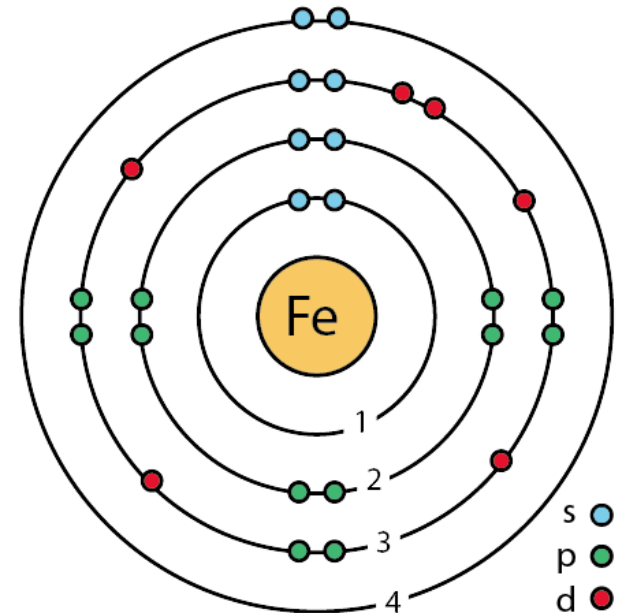
- The nucleus is small
- The atom is mostly empty space
- The nucleus is dense
- The nucleus is positively charged



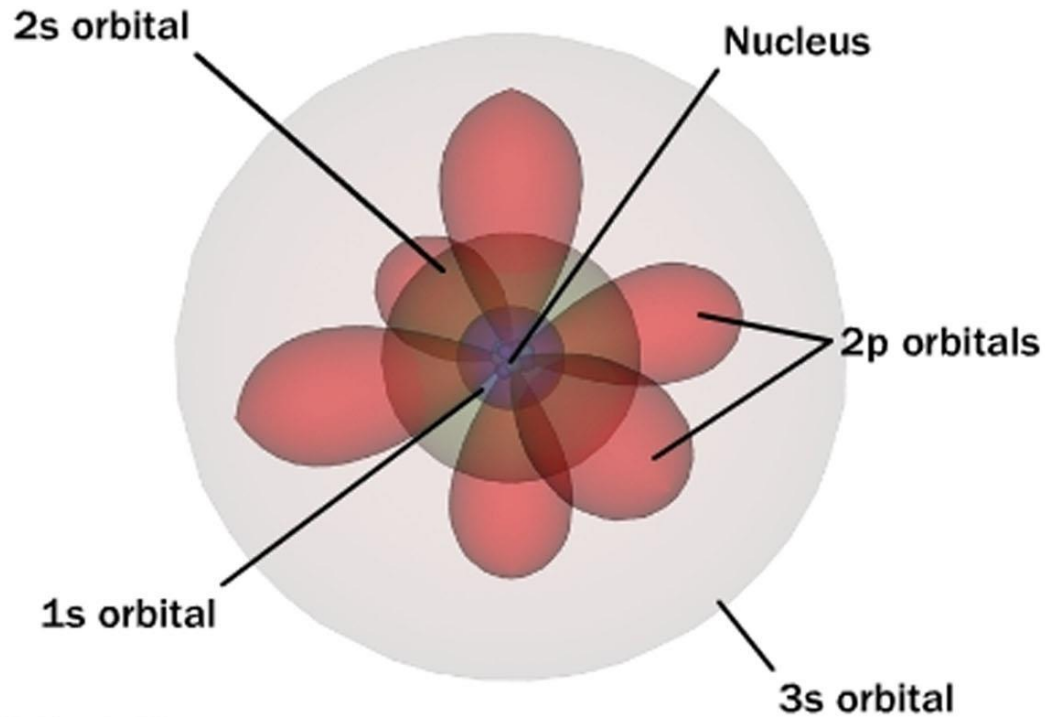
THE BOHR MODEL



The "planet" model because it looks like the planets revolving around the sun. These Electrons have "paths" that they follow around the Nucleus in the center. Usually we DRAW atoms like this but its not accurate!



The Quantum Model



©2001 How Stuff Works

This is a hard model to understand.
The Electrons don't follow paths, they are not objects at all! Instead they are pure charge that has a probability of being somewhere in those orbitals.

ATOMIC PARTICLES

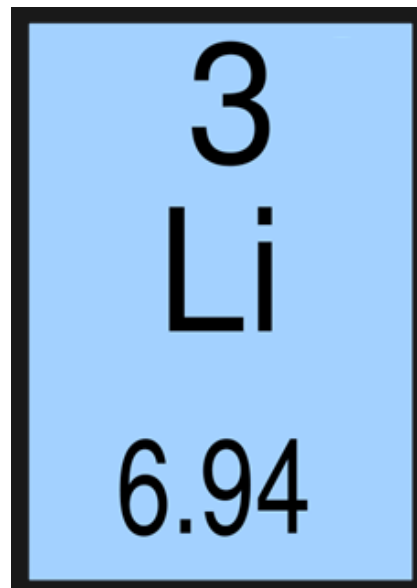
Particle	Charge	Mass #	Location
Electron	-1	0	Electron cloud
Proton	+1	1	Nucleus
Neutron	0	1	Nucleus

ATOMIC NUMBERS

We know: Nucleus has protons (p^+), neutrons (n^0), and electrons (e^-) are on the outside of nucleus

But how many of each???

Atomic Mass Number
(round to the nearest whole #)
of protons + # of neutrons



← **Atomic Number**
of protons
of electrons
=
of protons

ATOMIC NUMBER

The number of protons in the nucleus of each atom of that element.

6
C
Carbon
12.01

Element	# of protons	Atomic # (Z)
Carbon	6	6
Phosphorus	15	15
Gold	79	79

*Changing Protons makes a
new
ELEMENT
with a **NEW** name!*

***Sodium has 11 protons.
Take one away and it
has 10 and is no longer
sodium...it is now Neon!***

WHICH OF THE FOLLOWING DETERMINES THE IDENTITY OF AN ATOM?

- A. Number of protons**
- B. Number of electrons**
- C. Number of neutrons**
- D. Total number of protons and neutrons**
- E. Total number of protons and electrons**

WHICH OF THE FOLLOWING DETERMINES THE IDENTITY OF AN ATOM?

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- B. Number of electrons**
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MASS NUMBER

The number of protons and neutrons in the nucleus of an isotope.

$$\text{Mass \#} = p^+ + n^0$$



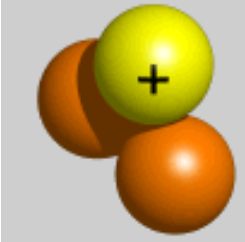
8
O
Oxygen
16.00

Nuclide	p ⁺	n ⁰	e ⁻	Mass #
Oxygen - 18	8	10	8	18
Arsenic - 75	33	42	33	75
Phosphorus - 31	15	16	15	31

Changing Neutrons makes
a new
ISOTOPE

ISOTOPES

Atoms of the same element having different masses due to varying numbers of neutrons.

Isotope	Protons	Electrons	Neutrons	Nucleus
Hydrogen-1 (protium)	1	1	0	
Hydrogen-2 (deuterium)	1	1	1	
Hydrogen-3 (tritium)	1	1	2	

AVERAGE ATOMIC MASSES

The average of all the naturally occurring isotopes of that element.

Isotope	Symbol	Composition of the nucleus	% in nature
Carbon-12	^{12}C	6 protons 6 neutrons	98.89%
Carbon-13	^{13}C	6 protons 7 neutrons	1.11%
Carbon-14	^{14}C	6 protons 8 neutrons	<0.01%

Carbon = 12.011

Changing Electrons makes
a new
ION

IONS

When you change the number of electrons in an atom.

Ion	Change	# of P to # of e-	Charge	Example symbol
Cation	Lost electrons	$P > e^-$	positive	Ca^{2+}
Anion	Gained electrons	$P < e^-$	negative	N^{3-}

Sodium

Normally:

11 protons +11

11 electrons -11

zero charge 0

Sodium

Take away: 11 protons +11

an electron 10 electrons -10

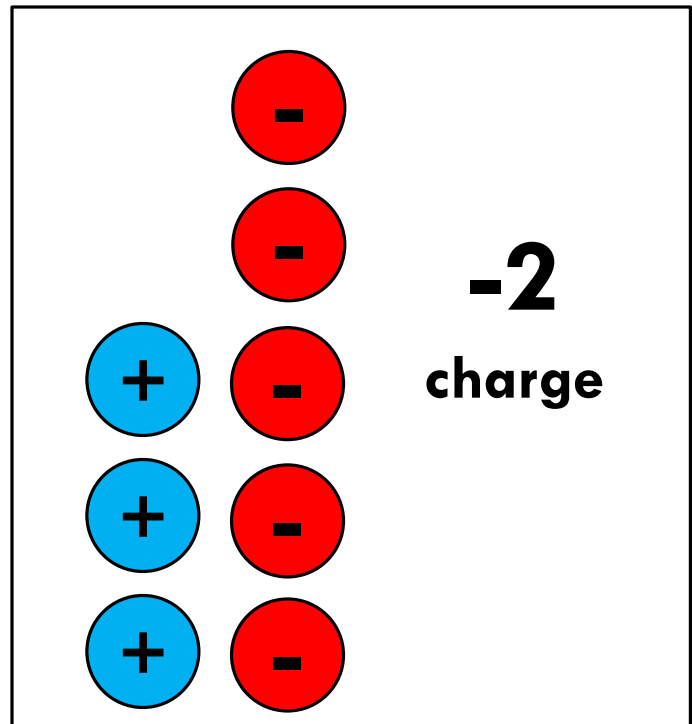
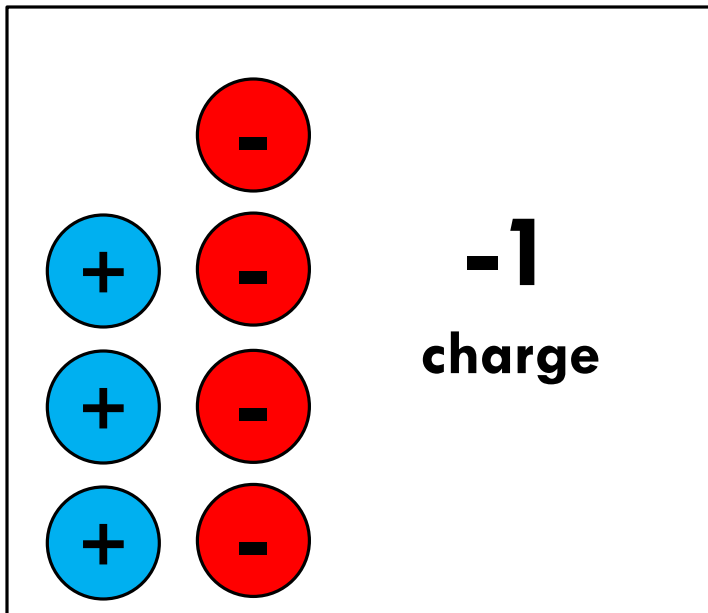
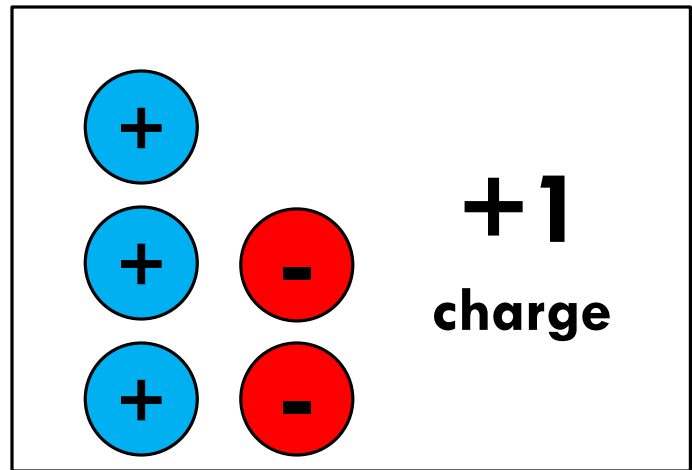
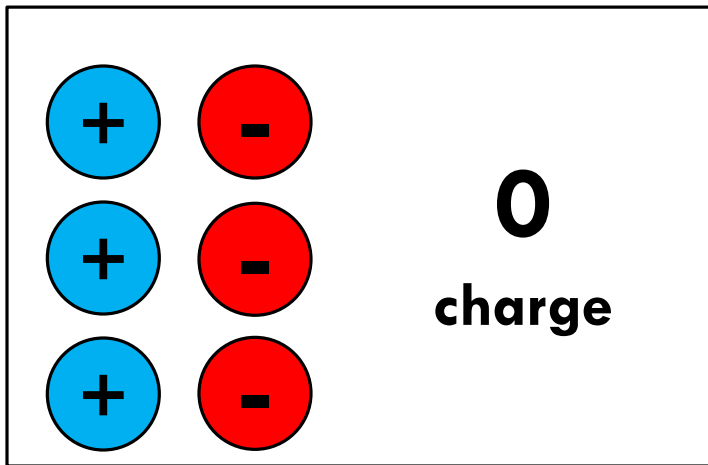
positive charge +1

Oxygen

<i>Normally:</i>	8 protons	+8
	<u>8 electrons</u>	<u>-8</u>
	zero charge	0

Oxygen

<i>Give 2 extra:</i>	8 protons	+8
<i>electrons</i>	<u>10 electrons</u>	-10
	negative charge	-2



IONS!

Oxygen

O⁻²

Negative

Anion

**Gained
electrons**

Sodium

Na⁺¹

Positive

Cation

**Took away
electrons**

Need some extra explanation?

[What are Isotopes Video](#)

<https://www.youtube.com/watch?v=EboWeWmh5Pg>

[What are Ions Video](#)

<https://www.youtube.com/watch?v=WWc3k2723IM>

LINK TO YOUTUBE VIDEO OF PRESENTATION

<https://youtu.be/vDzHcK1MUHo>