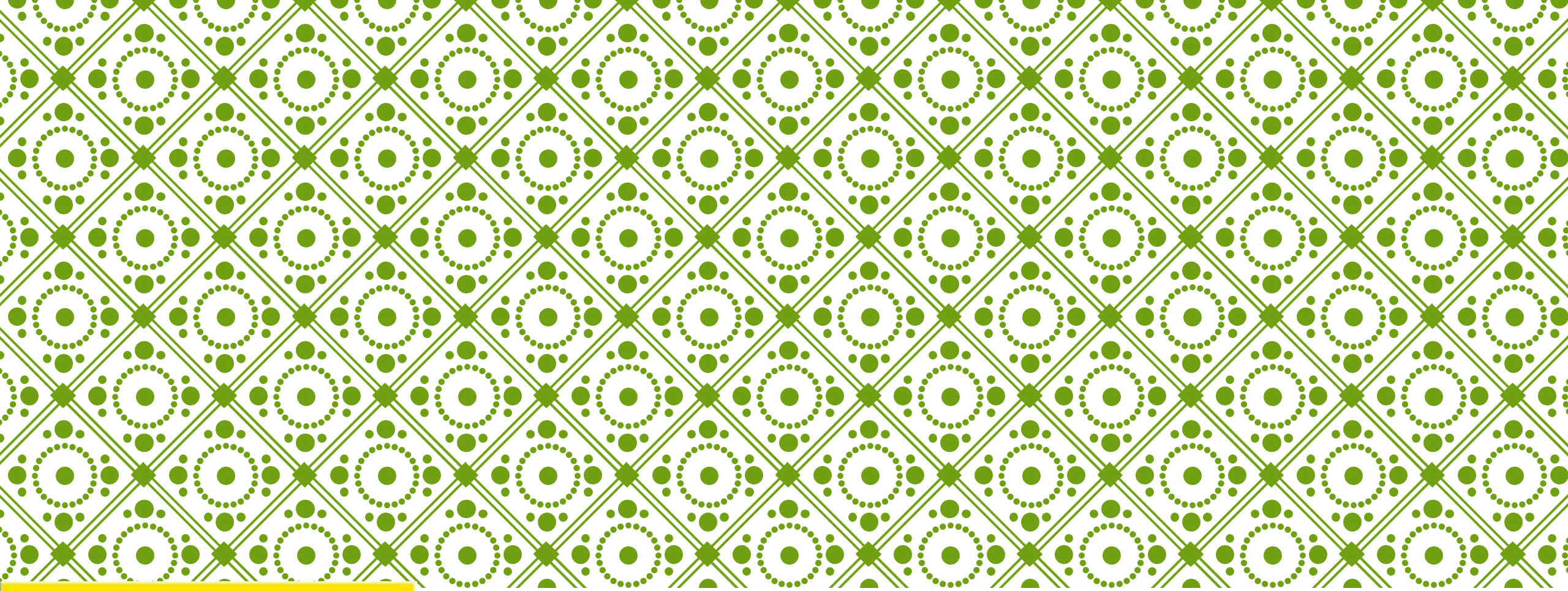

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# CHEM1011 LECTURE 1

Dr Shannan Maisey

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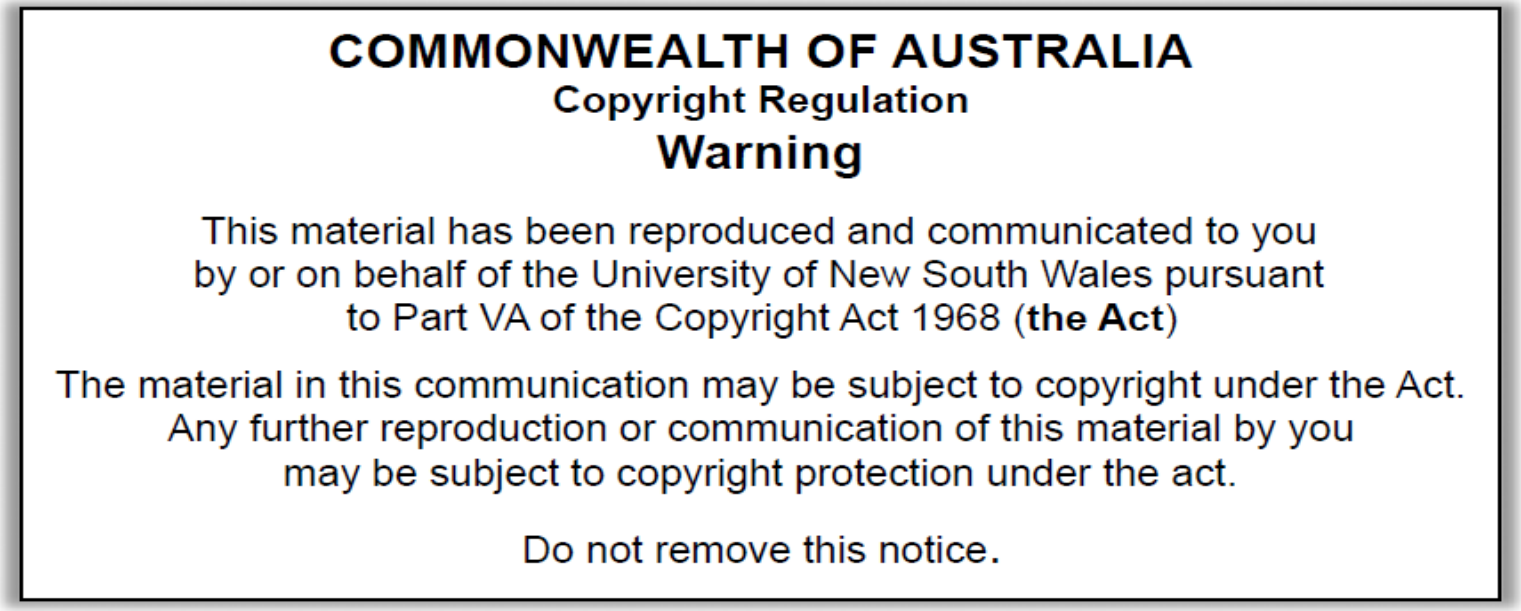

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# LECTURE RECORDINGS+

Log on through Moodle to:

- Take **digital notes** directly on my slides before, during and after the lecture
- **Bookmark** slides to come back to later
- **Flag** a slide if you're confused
- Complete **activities** (polls & short answers) before the lecture
- Ask **questions** "anonymously" – *I can still see who it is, fellow students can't*

I will use Participoll and Slido during my lectures but analyse LR+ ones too after the lecture

*This will take you to all Chem1011 lectures*

*This will take you to the specific lecture as labelled*

# WHAT IS PARTICIPOL?

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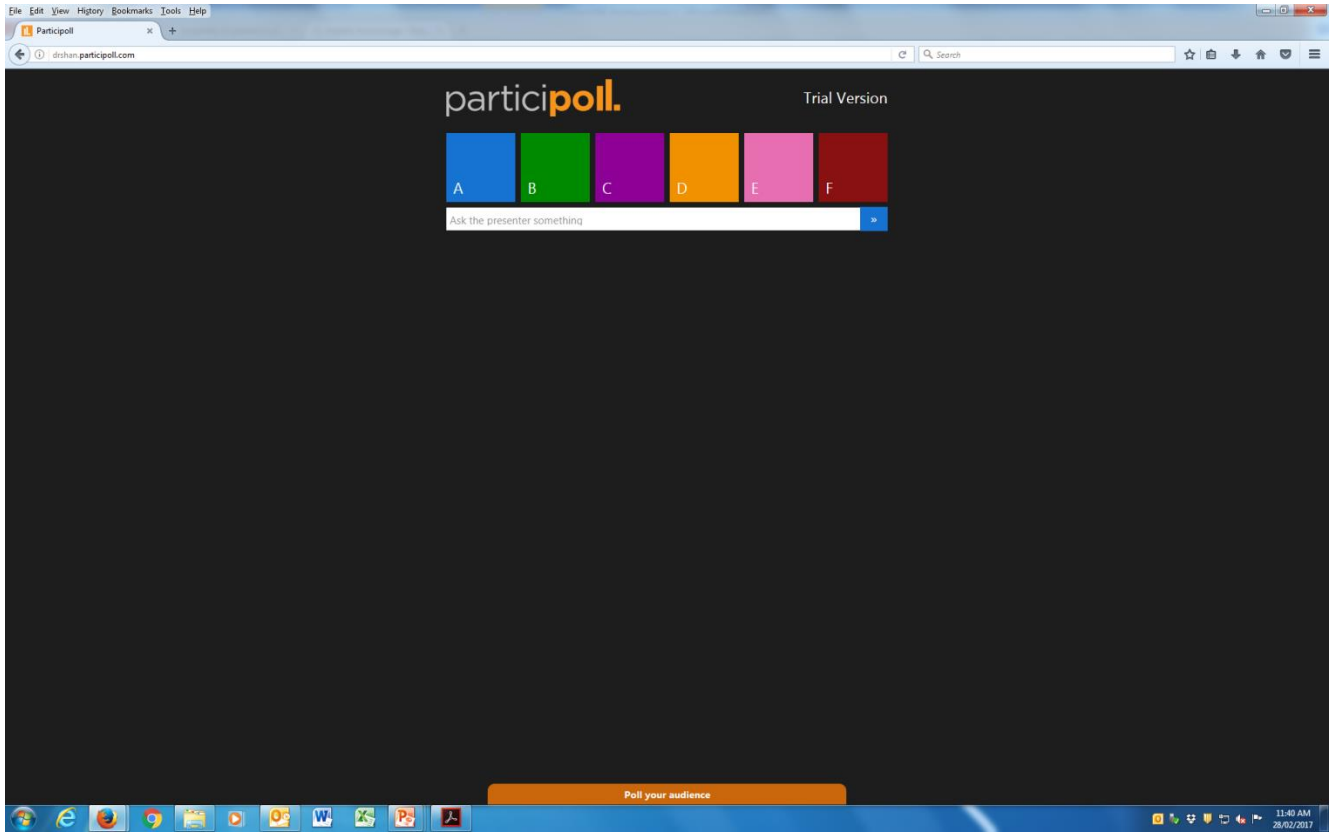
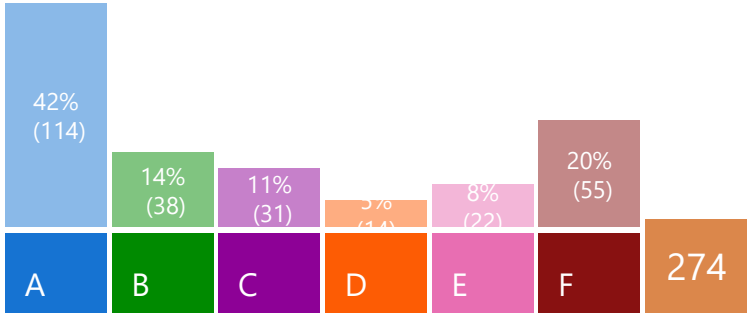



What is your favourite colour?

A. Blue
B. Green
C. Purple
D. Orange
E. Pink
F. Other




vote at DrShan.participoll.com

# LEARNING OBJECTIVES - WEEK 1 (REVISION)

**After this week you should be able to:**

– Name the constituent parts of an atom, together with their relative masses and charges.

– Calculate numbers of protons, neutrons, electrons in atoms of a particular element.

– Name simple inorganic and organic compounds and write the formulae for simple compounds from their name.

– Write and balance simple chemical equations.

– Understand the quantity “amount of substance” and the SI unit ‘mole’

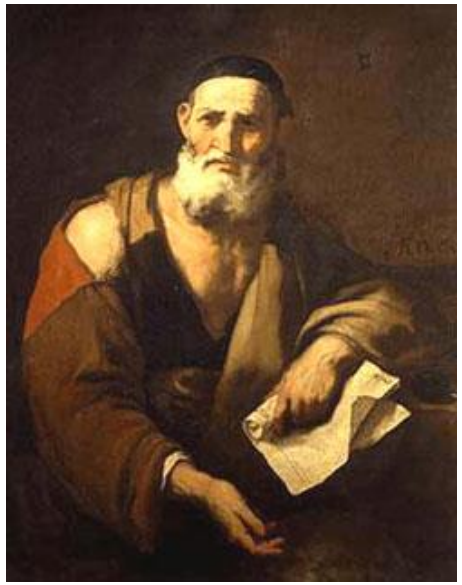
– Calculate molar mass from chemical formula.

– Calculate mass fraction of each element in a compound and determine empirical formula from mass fractions.

– Calculate concentration of solutions in various units. Calculate yield in a chemical reaction, identify the limiting reagent.

# INFINITE DIVISIBILITY?

Ancient Greek philosopher Leucippus is credited with first conceiving atomic theory….



The Greek word *átomos* (*ἄτομος*), means "uncuttable“ or“ indivisible“…the point at which a further cut is ‘impossible’ (but we now know that is not the case….)

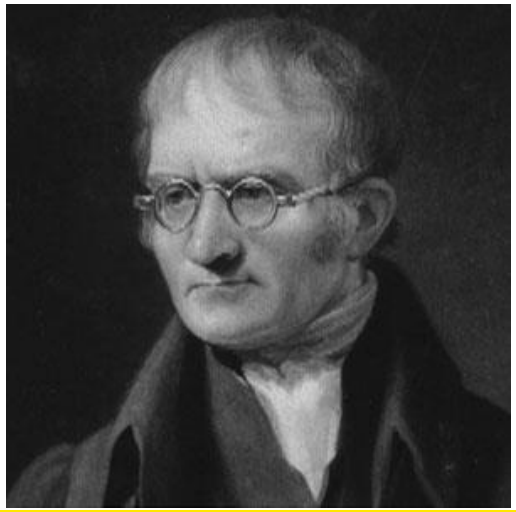
# THE ATOM

Democritus: “There be atoms and there be void.”

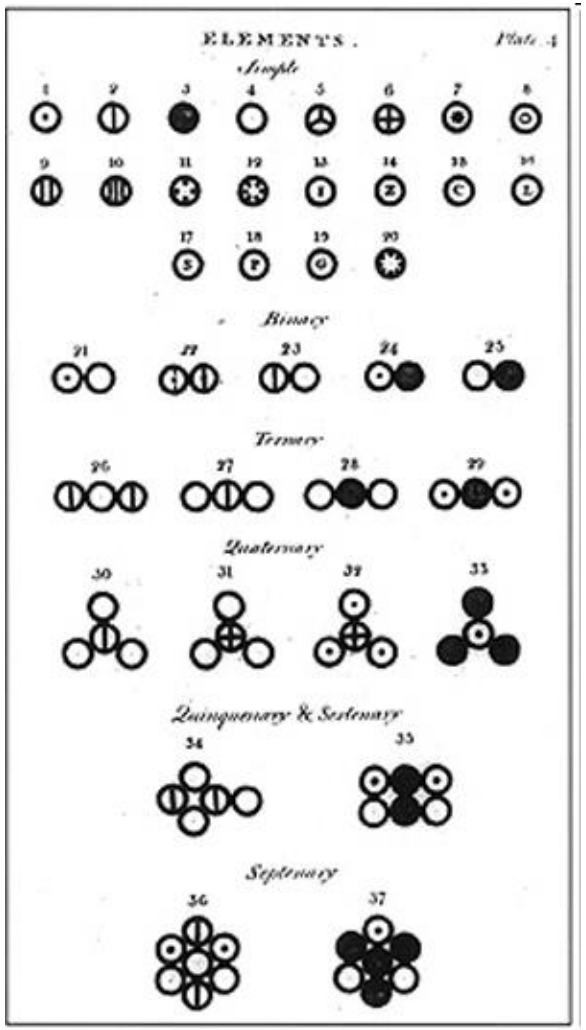
Aristotle: “Earth, Air, Fire & Water.”

Alchemists: Base metals to gold.

Dalton: First atomic theory supported with observation and measurement.



John Dalton
1766-1844




*First page of Dalton's "A New System of Chemical Philosophy", published in 1808*



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# DALTON'S ATOMIC THEORY: (1803) – mostly correct.

- All matter consists of tiny particles :- "ATOMS"
- Atoms of one element can neither be subdivided nor changed into atoms of another element.
- Atoms can neither be created, nor destroyed.
- All atoms of the same element are identical in size, mass and other properties.
- Atoms of one element differ in mass and other properties from the atoms of other elements.
- Chemical combination is the union of atoms of different elements, the elements combine in simple, whole number ratios with each other.

# THE ATOMIC THEORY (THURSDAY'S LECTURE)

## Law of conservation of mass (Lavoisier)

- No detectable gain or loss of mass occurs in chemical reactions. Mass is conserved.

## Law of definite proportions (J.L.Proust)

- In a given chemical compound, the elements are always combined in the same proportions by mass.

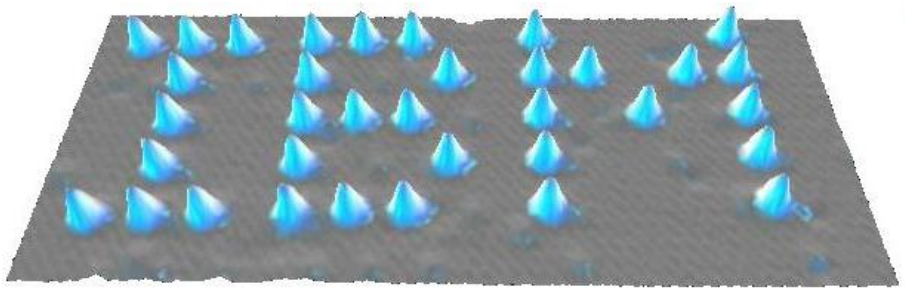
## Law of multiple proportions (post Dalton's theory)

- Whenever two elements form more than one compound, the different masses of one element that combine with the same mass of the other element are in the ratio of small whole numbers… law of stoichiometry

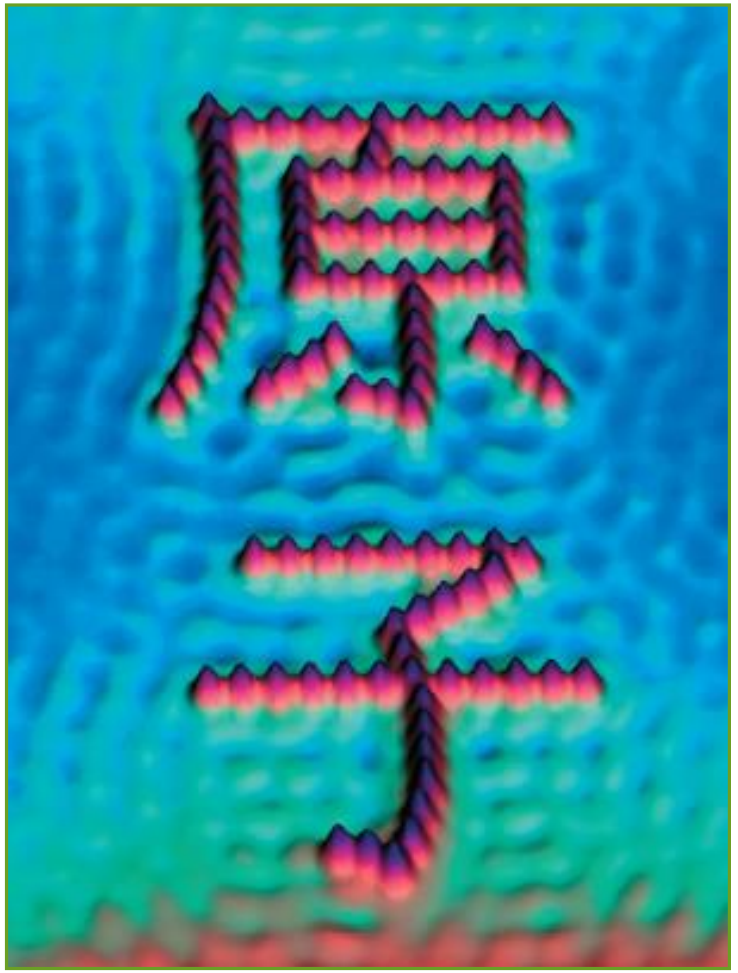
# THE ATOMIC THEORY – FACT!

Chemists no longer talk of atomic theory, we talk of atomic fact

- Scanning tunnel microscopy and atomic force microscopy allow us to view and manipulate individual atoms



*Above image: Don Eigler*



# PARTS OF AN ATOM

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An atom is made up of:

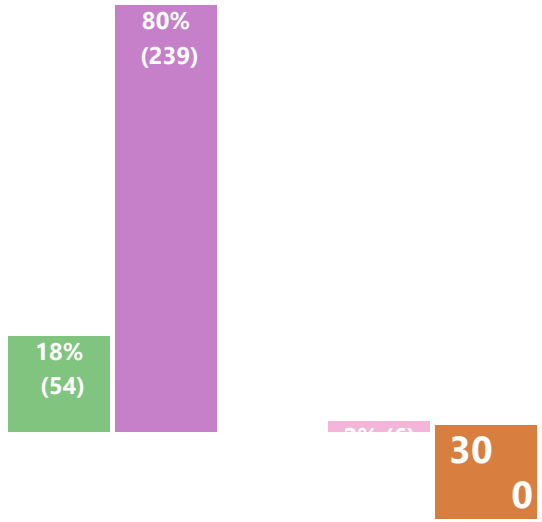
A Elements and compounds

B Electrons and protons

C A nucleus and electrons

D Neutrons

E Don't know

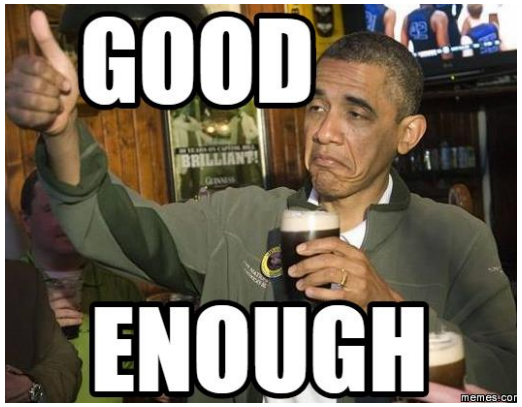


# THE USE OF MODELS IN CHEMISTRY

Vs


*Source: Universal Pictures*

# DALTON'S MODEL OF THE ATOM

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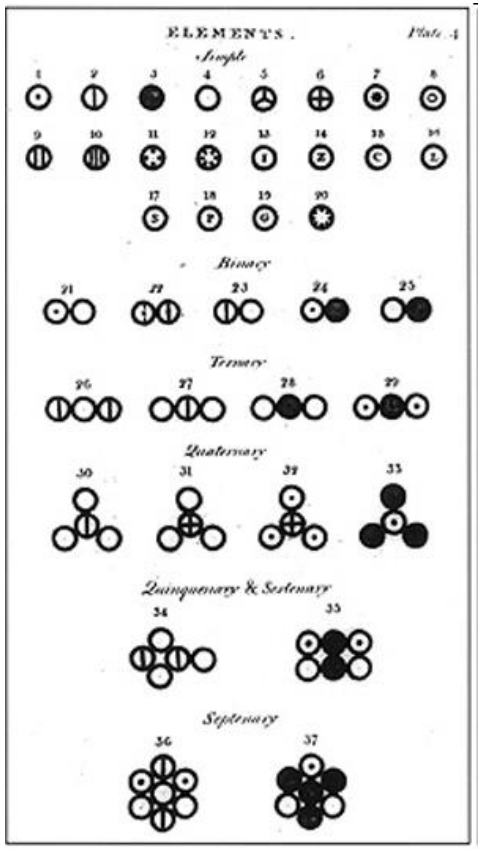




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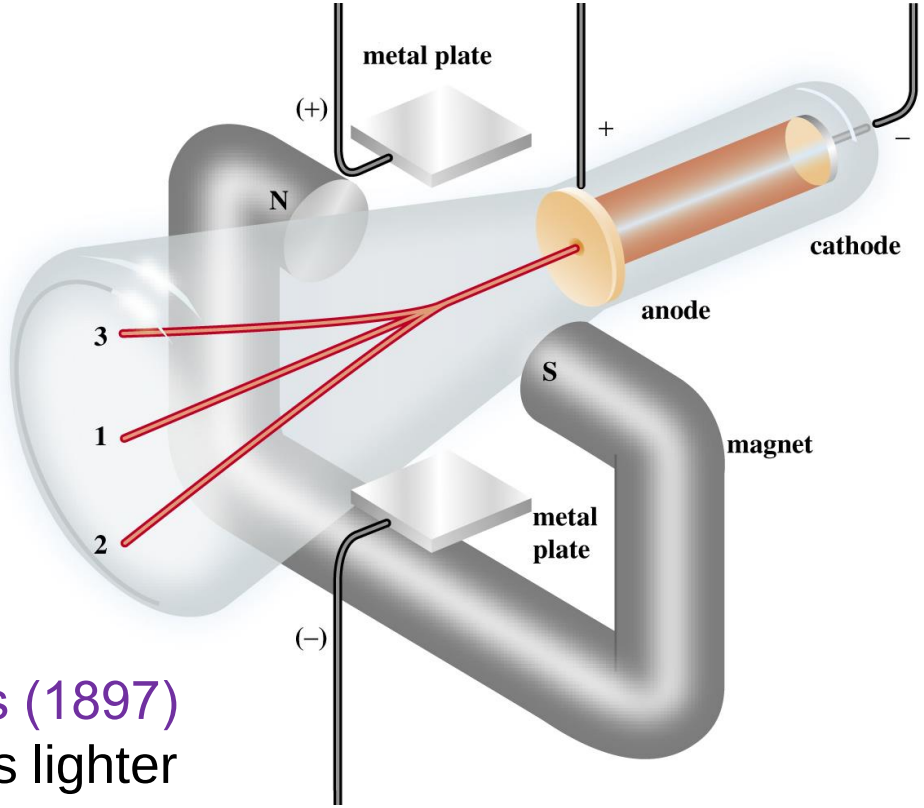
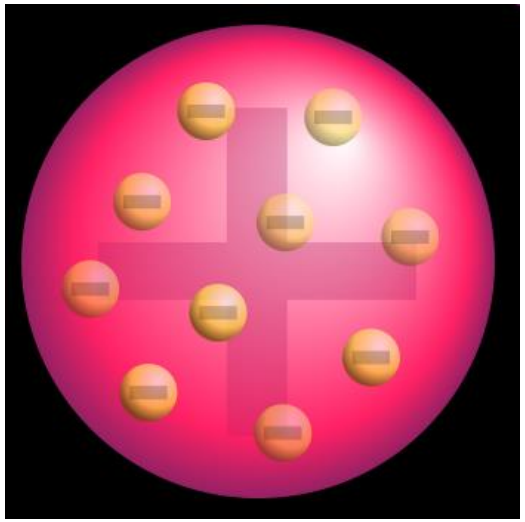
# CRITICAL EXPERIMENTS POST-DALTON

The Cathode Ray:- A stream of electrons.
(Faraday, Crookes, Stoney, Thomson, Millikan)




J.J. Thomson's experiment to measure the mass of cathode rays (1897)
Showed they were made of particles, but were around 1800 times lighter than the lightest atom, hydrogen. The negatively charged particles were named *electrons*.

# THE "PLUM PUDDING" MODEL OF THE ATOM



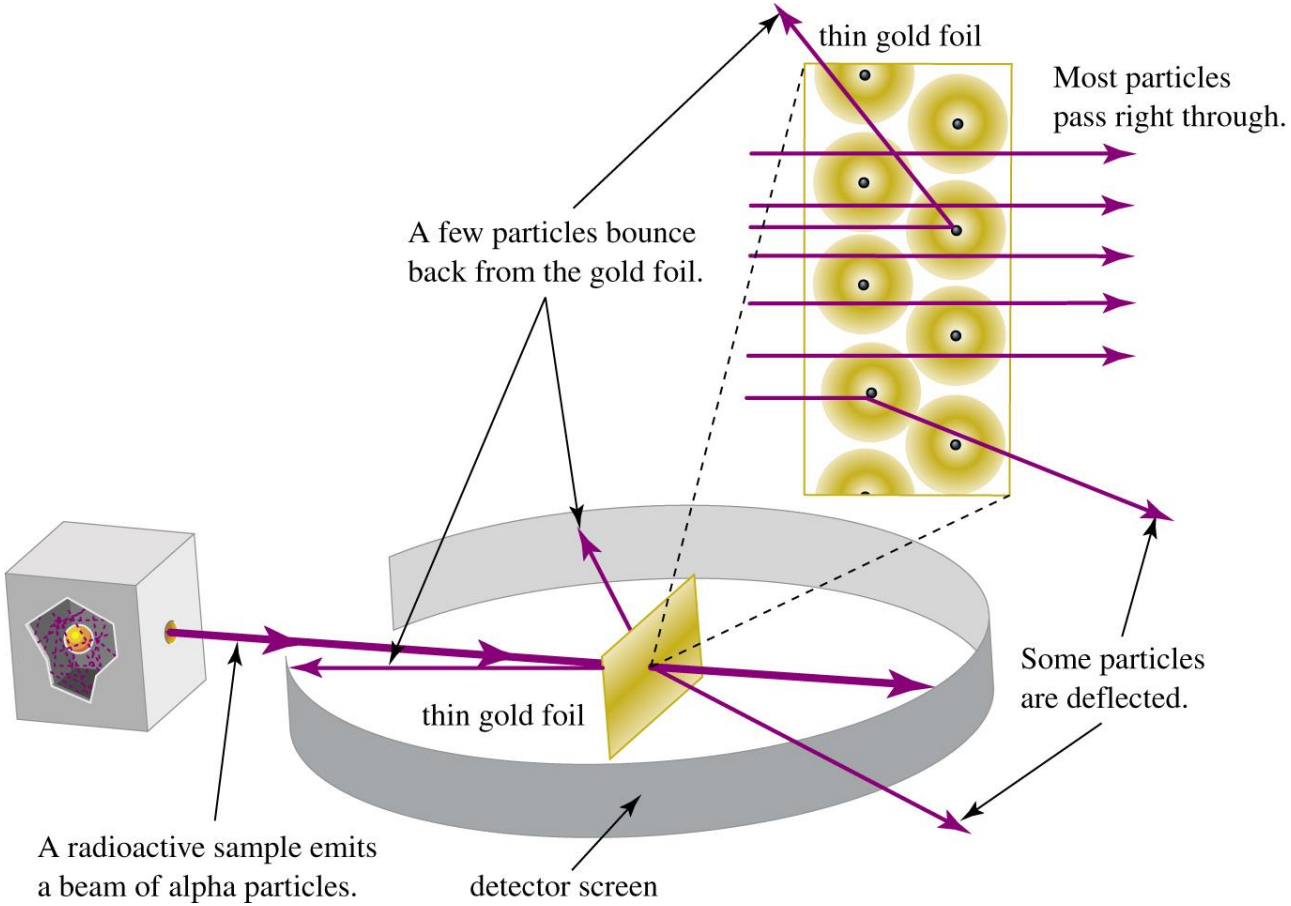
*"the atoms of the elements consist of a number of negatively electrified corpuscles enclosed in a sphere of uniform positive electrification"*
J.J. Thomson, 1904.

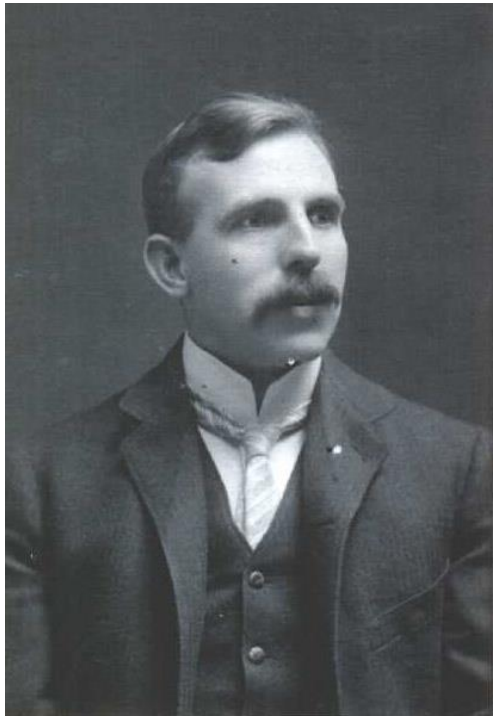
- Accounts for the presence of electrons but overall neutral charge

**- Disproved by Rutherford's experiment**

# CRITICAL EXPERIMENTS POST-DALTON

alpha - Particle scattering:- (Rutherford)



Showed that the mass of an atom is concentrated in a very small volume – the nucleus

# ATOMS AND THEIR COMPOSITION

ATOM:
- Smallest unit of an element,
- Composed of three elementary particles – protons, neutrons and electrons
- protons and neutrons are in the nucleus,
- electrons are in surrounding shells (more on this later!).

Neutrons have mass about the same as a proton but no charge.

Charges: Proton +1; electron -1, neutrons 0.

Masses:

- Proton mass = $1.673 \times 10^{-27}$ kg (1)
- Neutron mass = $1.675 \times 10^{-27}$ kg (1)
- Electron mass = $9.109 \times 10^{-31}$ kg (1/1833)

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# SIZE AN ATOM

An atom the size of a rugby stadium would have a nucleus the size of _____?

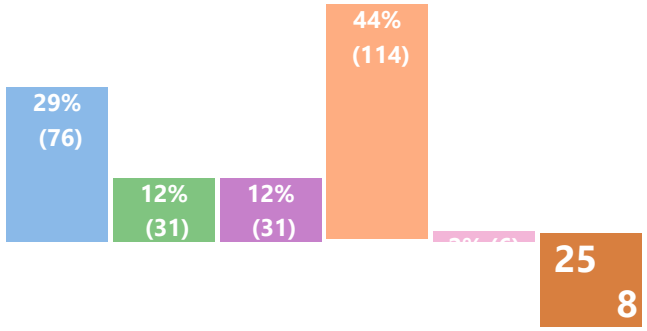
A A rugby ball

B A mole

C The playing field

D A pea

E Don't know



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