Classification of matter

- We can broadly classify matter by how difficult it is to separate

PURE SUBSTANCES

- CANNOT be separated into different materials by PHYSICAL PROCESSES

Examples:

Table salt, gold, silver, nitrogen, oxygen, carbon, hydrochloric acid, carbon dioxide, ethanol (grain alcohol), water, silicon dioxide

MIXTURES

- CAN be separated into other materials by PHYSICAL PROCESSES

Examples:

salt water, vodka, air, toilet bowl cleaner, beef, macaroni and cheese, dirt

More on PURE SUBSTANCES

- Pure substances can be further classified, depending on how easy it is to separate them by CHEMICAL PROCESSES

ELEMENTS

- Cannot be broken down into simpler substances using physical or chemical means

- Elements are the building blocks of chemistry! They are the simple things from which all other things are formed!

- Listed on the PERIODIC TABLE OF THE ELEMENTS

Examples:

gold, silver, carbon, nitrogen, oxygen

COMPOUNDS

-Can be broken down into simpler substances using chemical means

- Are made of ELEMENTS combined in simple, fixed ratios

- A compound, no matter how it was made, has a definite ratio of one atom to another (LAW OF CONSTANT COMPOSITION)

H_2O: 2 parts hydrogen to one part oxygen!

Examples:

carbon dioxide, hydrochloric acid, ethanol, water

More on MIXTURES

- Mixtures can be further classified based on uniformity

HOMOGENEOUS MIXTURES

- uniform in composition and properties throughout

- physical properties the same at any point in the mixture

Examples:

salt water, toilet bowl cleaner, vodka

"solutions"

HETEROGENEOUS MIXTURES

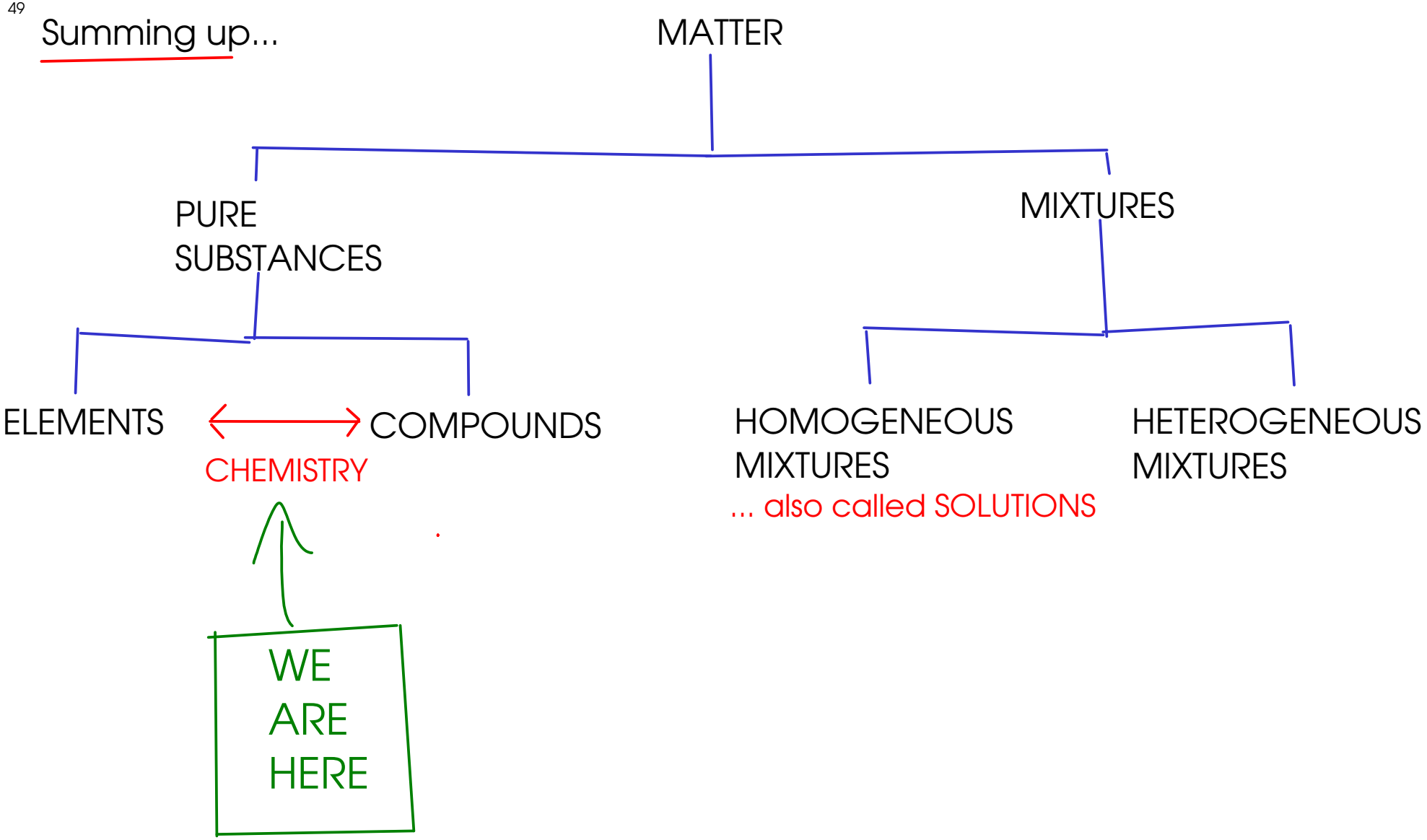
- nonuniform

- physical properties may differ (sometimes dramatically) at different points in the mixture

Examples:

beef, dirt, macaroni and cheese

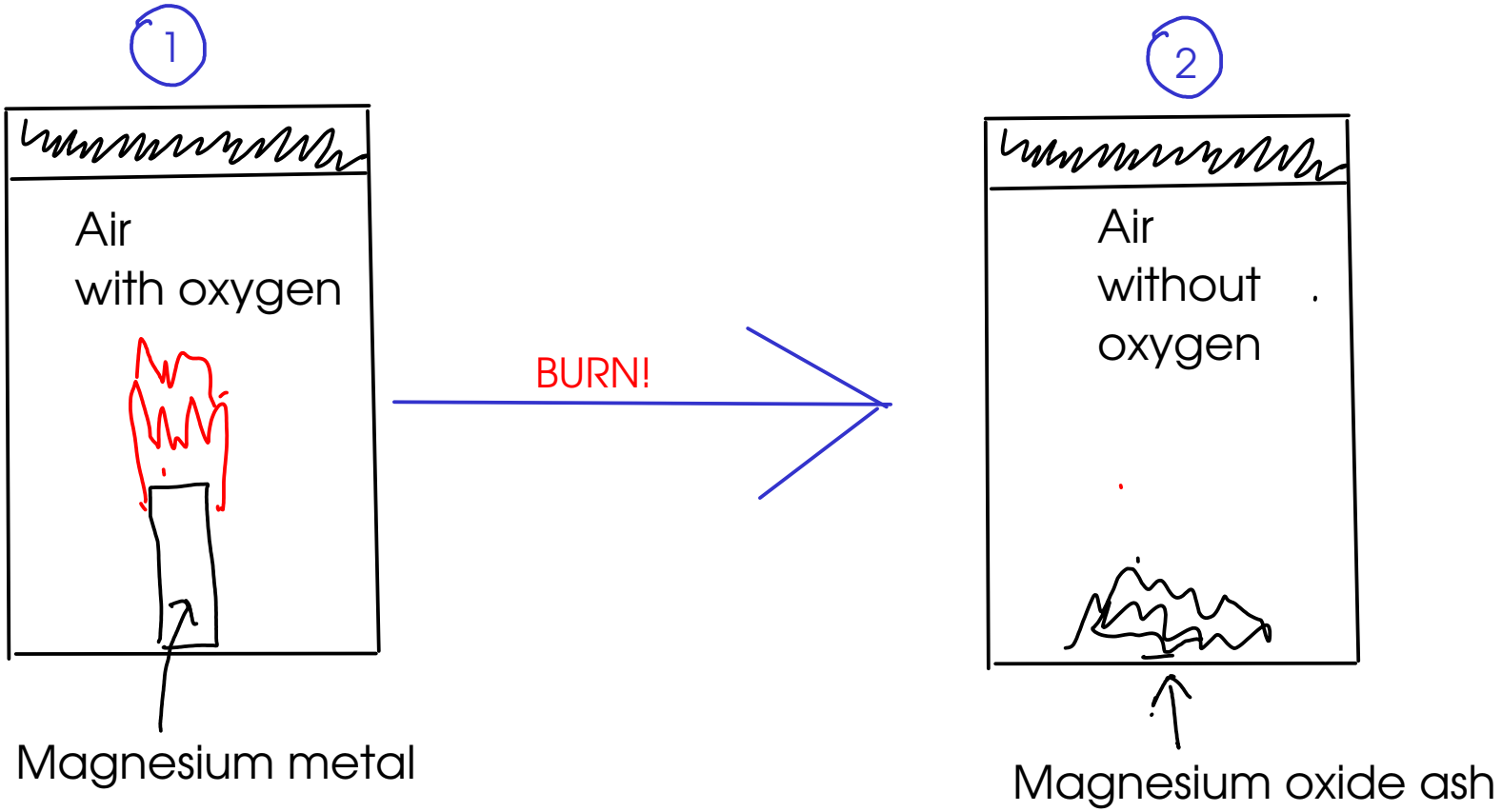
Summing up...


MATTER
PURE SUBSTANCES
MIXTURES
ELEMENTS
COMPOUNDS
CHEMISTRY
HOMOGENEOUS MIXTURES
... also called SOLUTIONS
HETEROGENEOUS MIXTURES
WE ARE HERE

Conservation of mass

- During any chemical or physical process, the overall amount of mass remains constant, even if the chemical identity or physical state of the matter involved changes

* Total mass remains constant from (1) to (2), even though the mass of the GAS decreases and the mass of the SOLID increases after combustion!



End of material for Test #1

Test 1: JUNE 12, 2012 (TUESDAY)

Chapters 1, 2, 3

DALTON'S ATOMIC THEORY

- 1808: Publication of Dalton's "A New System of Chemical Philosophy", which contained the atomic theory

- Dalton's theory attempted to explain two things:

1. CONSERVATION OF MASS
2. LAW OF DEFINITE PROPORTIONS (also called the LAW OF CONSTANT COMPOSITION): All pure samples of a given compound contain the same proportion of elements by mass

The parts of Dalton's theory

1. Matter is composed of small, chemically indivisible ATOMS

2. ELEMENTS are kinds of matter that contain only a single kind of atom. All the atoms of an element have identical chemical properties.

3. COMPOUNDS are kinds of matter that are composed of atoms of two or more ELEMENTS which are combined in simple, whole number ratios. 1:1 or 1:2 or 2:3, etc.

Most importantly,

4. CHEMICAL REACTIONS are REARRANGEMENTS of existing atoms to form new compounds.

- Atoms are not gained or lost during a chemical reaction.

- Atoms do not change their identity during a chemical reaction.

- All the atoms that go into a chemical reaction must go out again!

Another look at chemical reactions

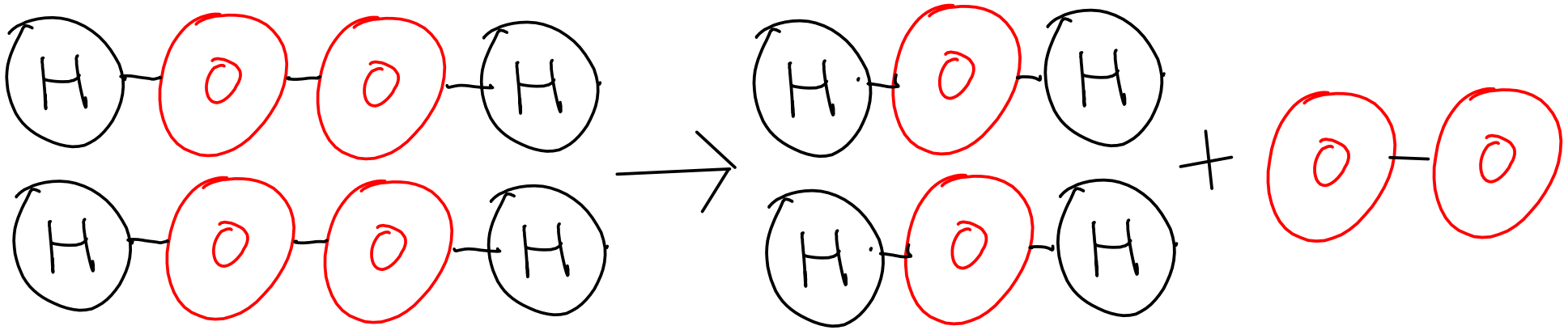
You observed this reaction in the oxygen lab:

HYDROGEN PEROXIDE → WATER + OXYGEN GAS

$H_2O_2 \rightarrow H_2O + O_2$

... but wouldn't this mean that somehow an extra oxygen atom would form?

Not according to Dalton's theory. Dalton's theory would predict a different RATIO of water and oxygen would form:



$2\ H_2O_2 \rightarrow 2\ H_2O + O_2$

- Dalton's theory sets LIMITS on what can be done with chemistry. For example:

1. Chemistry can't convert lead (an element) into gold (another element). Sorry, alchemists!

2. You can't have a compound form in a chemical reaction that contains an element that was not in your starting materials.

3. You can only make a certain amount of desired product from a fixed amount of starting material.

... but Dalton's theory said nothing about WHY atoms behave the way they do. What makes gold ... gold?

Atomic structure

- Until the early 20th century, chemists considered atoms to be indivisible particles.
- The discovery of SUBATOMIC PARTICLES changed the way we view atoms!

The subatomic particles

PROTON

- a small, but relatively massive particle that carres an overall unit POSITIVE CHARGE

NEUTRON

- a small, but relatively massive, particle that carries NO CHARGE
- slightly more massive than the proton

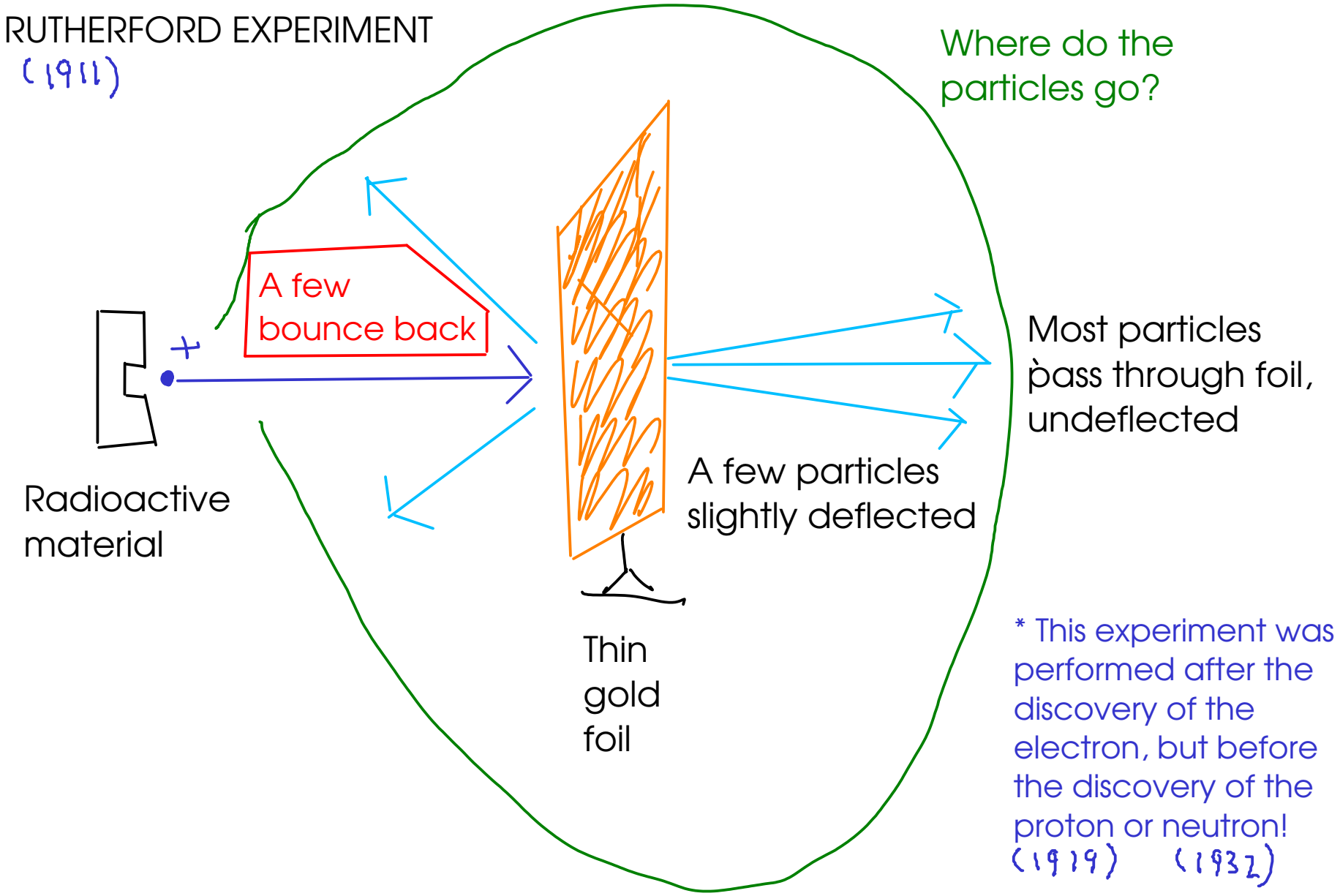
ELECTRON

- a small particle that carries an overall unit NEGATIVE CHARGE
- about 2000 times LESS massive than either protons or neutrons

... So these particles were all thought to be parts of the atom. But how were these parts put together?

Putting it together...

- In the early 20th century, there was a debate on the structure of the atom.



NUCLEAR MODEL

- Atoms are mostly empty space

- NUCLEUS, at the center of the atom, contains protons and neutrons. This accounts for almost all the mass of an atom

- Electrons are located in a diffuse ELECTRON CLOUD surrounding the nucleus