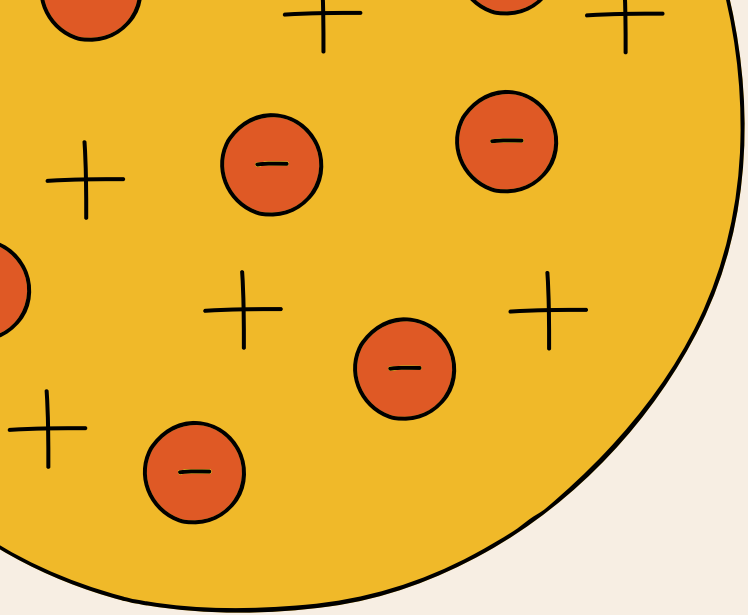
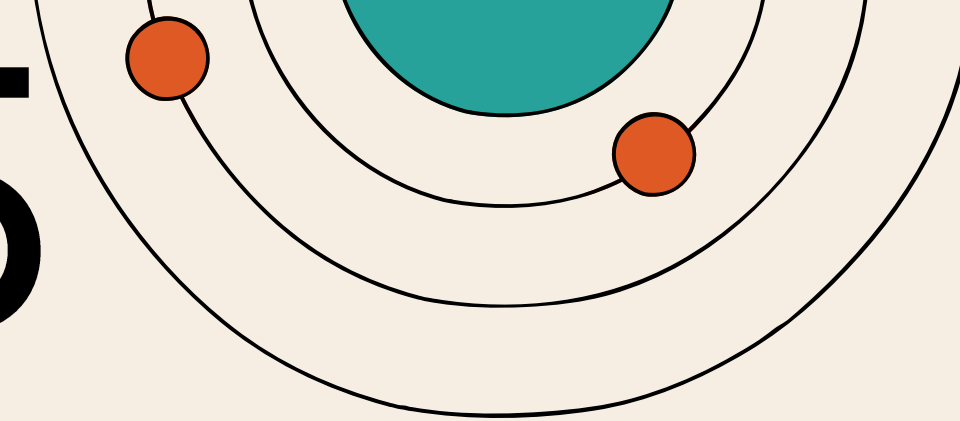




CHAPTER 5

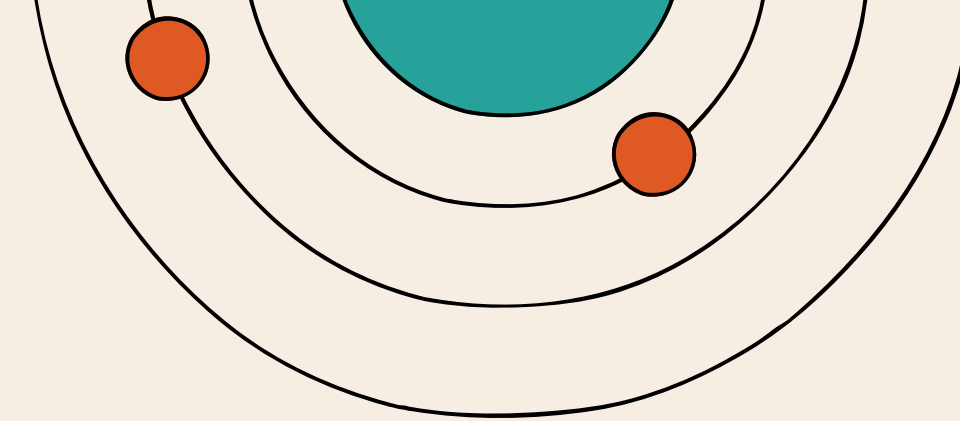
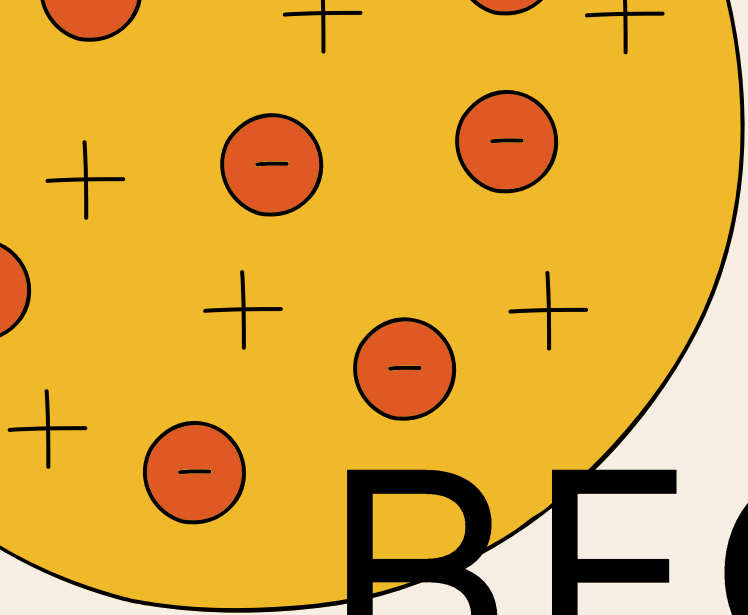


PIECING TOGETHER THE

ATOMIC

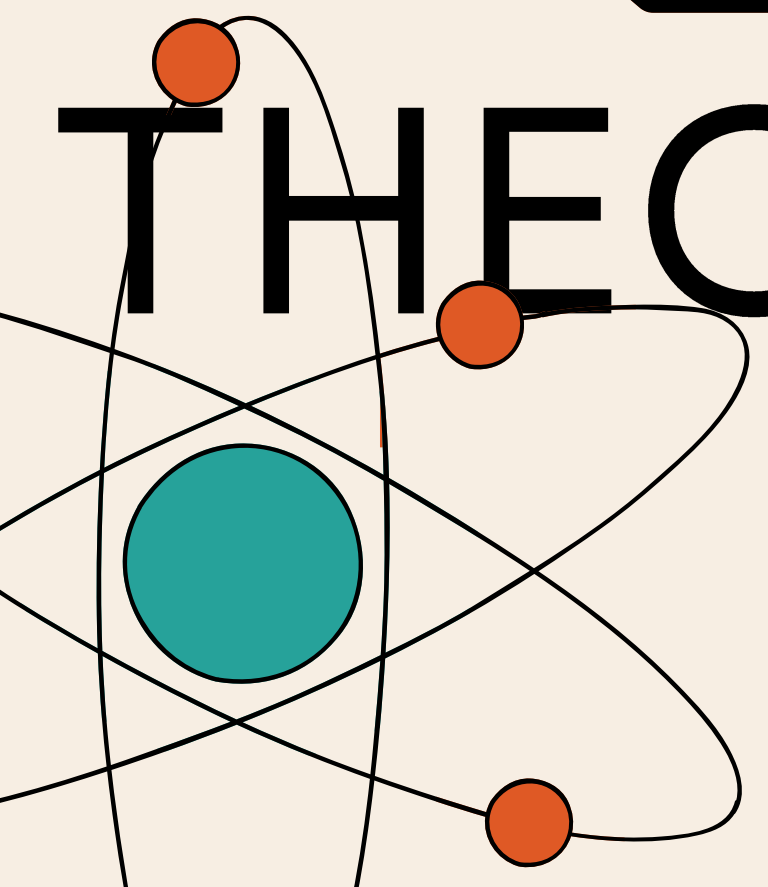
PICTURE





LESSON 1
BEGINNINGS OF THE

ATOMIC



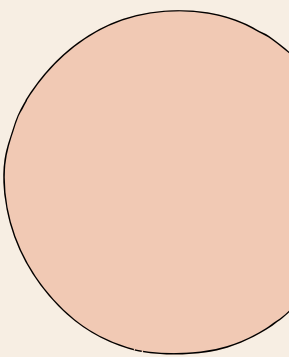
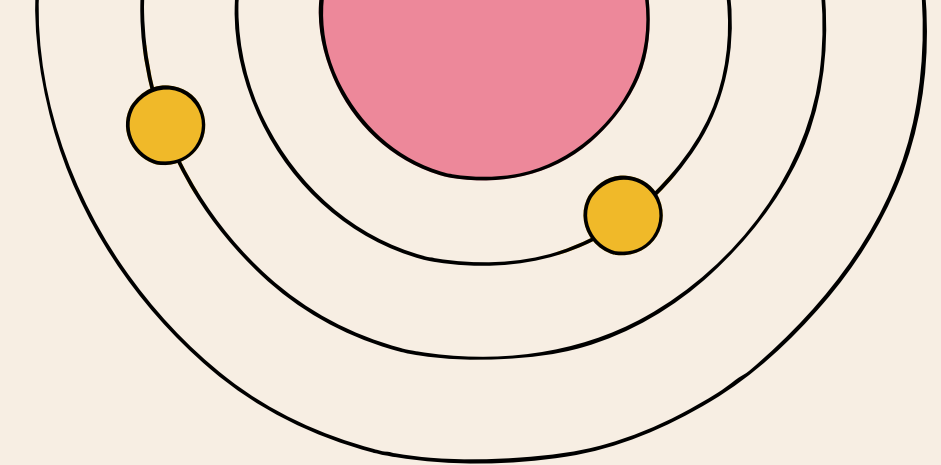
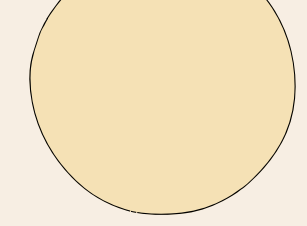
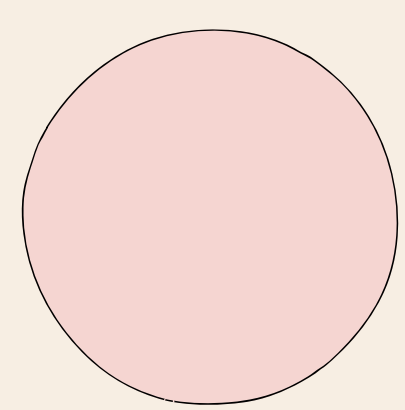
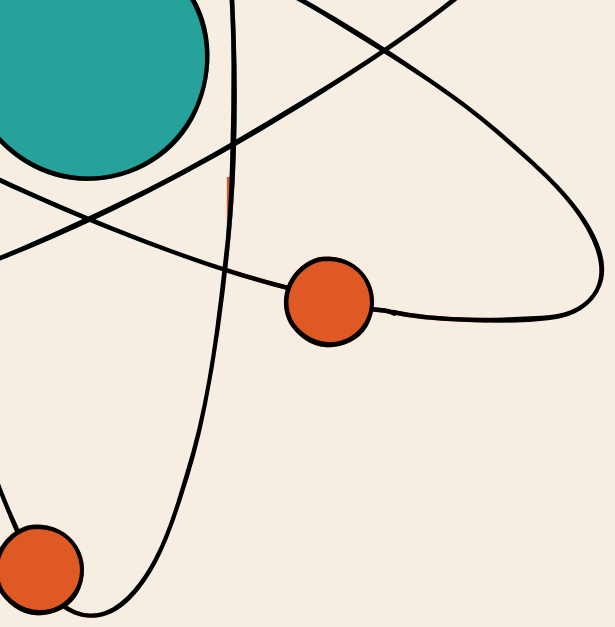
THEORY OF MATTER



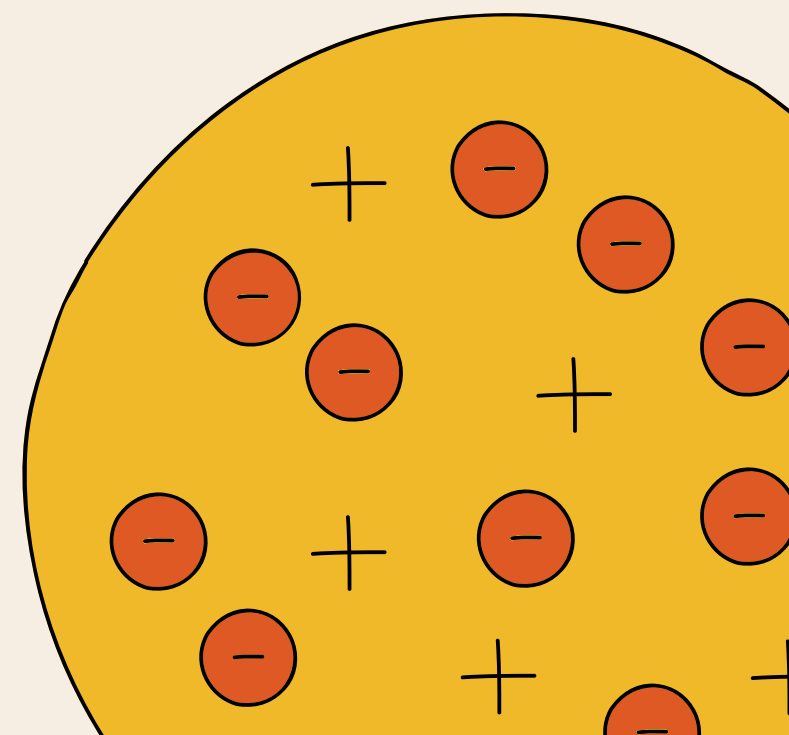
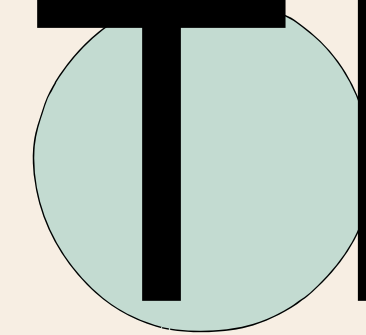
LEARNING OBJECTIVES

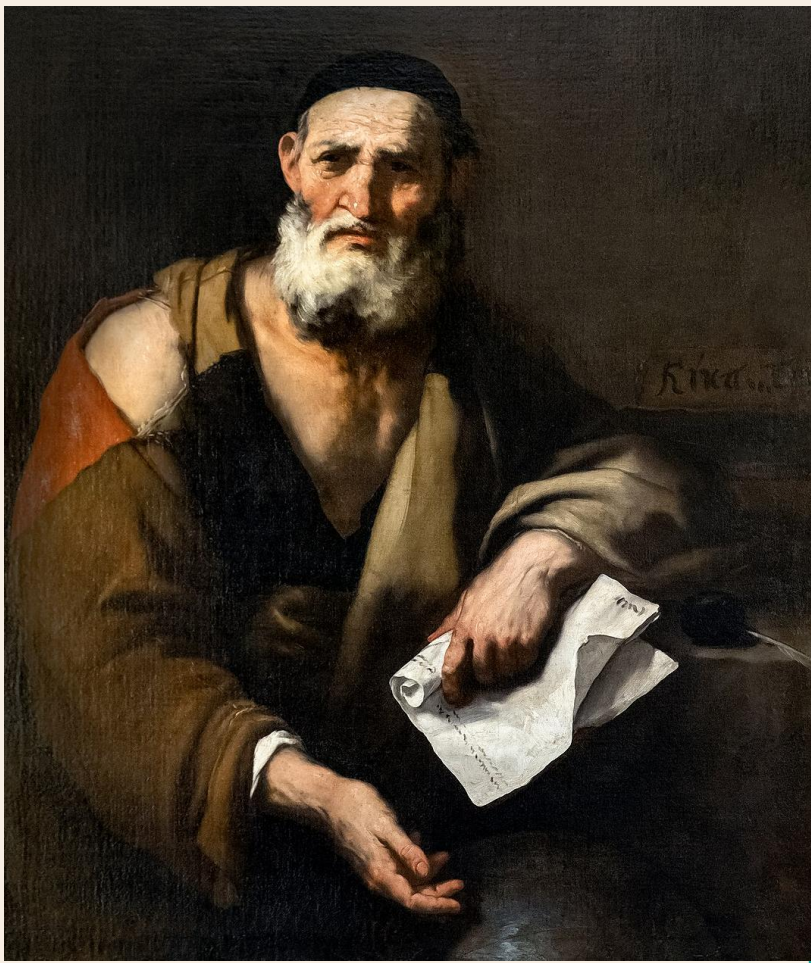


- 1 describe matter and its composition according to early atomist philosophers
- 2 Explain the nature and composition of matter according to Dalton's postulates that pioneered the modern atomic model
- 3 Define and trace the origins of important scientific laws that inspired Dalton's atomic theory



EARLIEST CONCEPT OF MATTER





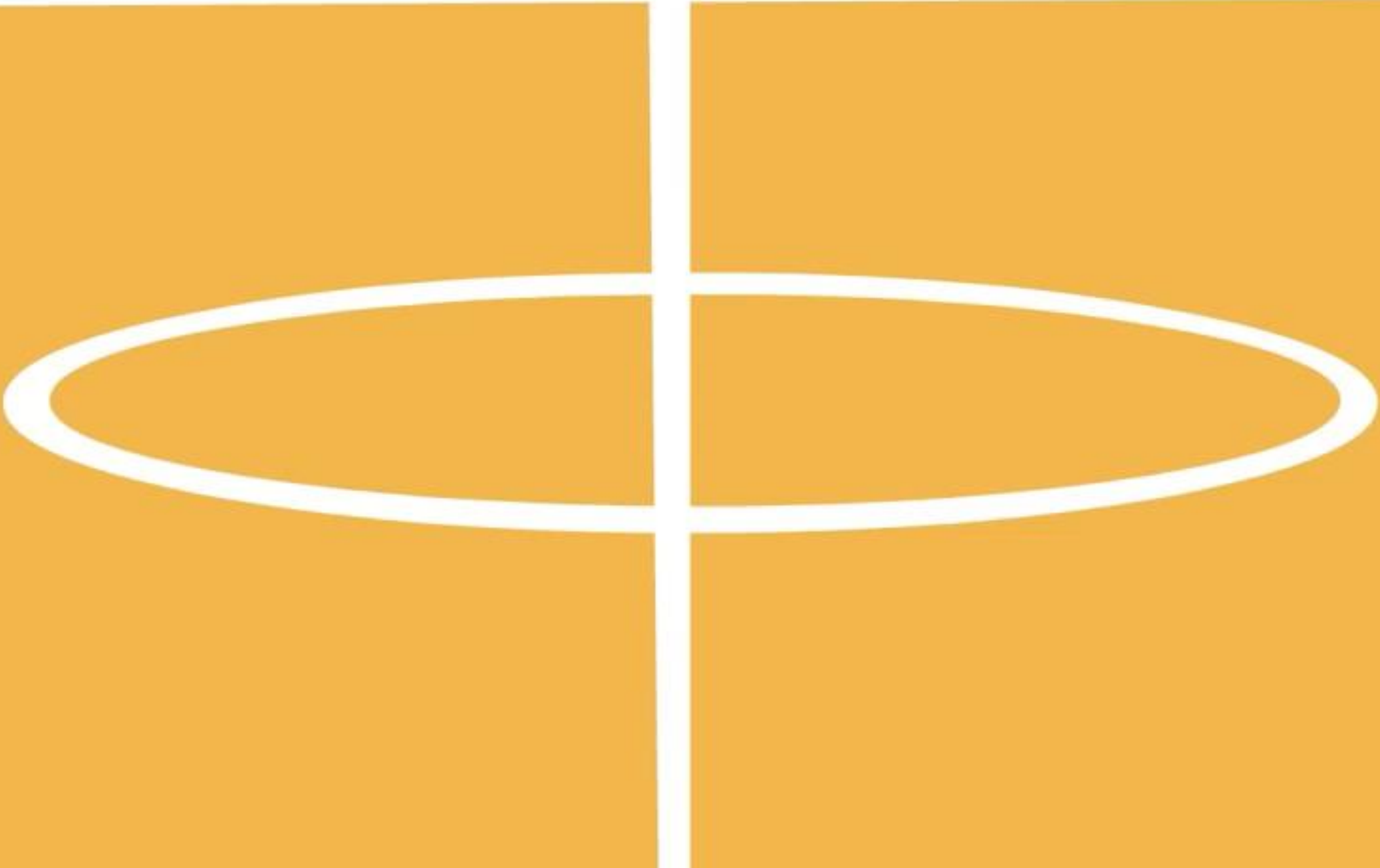
LEUCIPPUS & DEMOCRITUS

500 BCE



- Proposed that matter is composed of tiny, indivisible particles they called *atomos* which means “uncuttable” in Greek

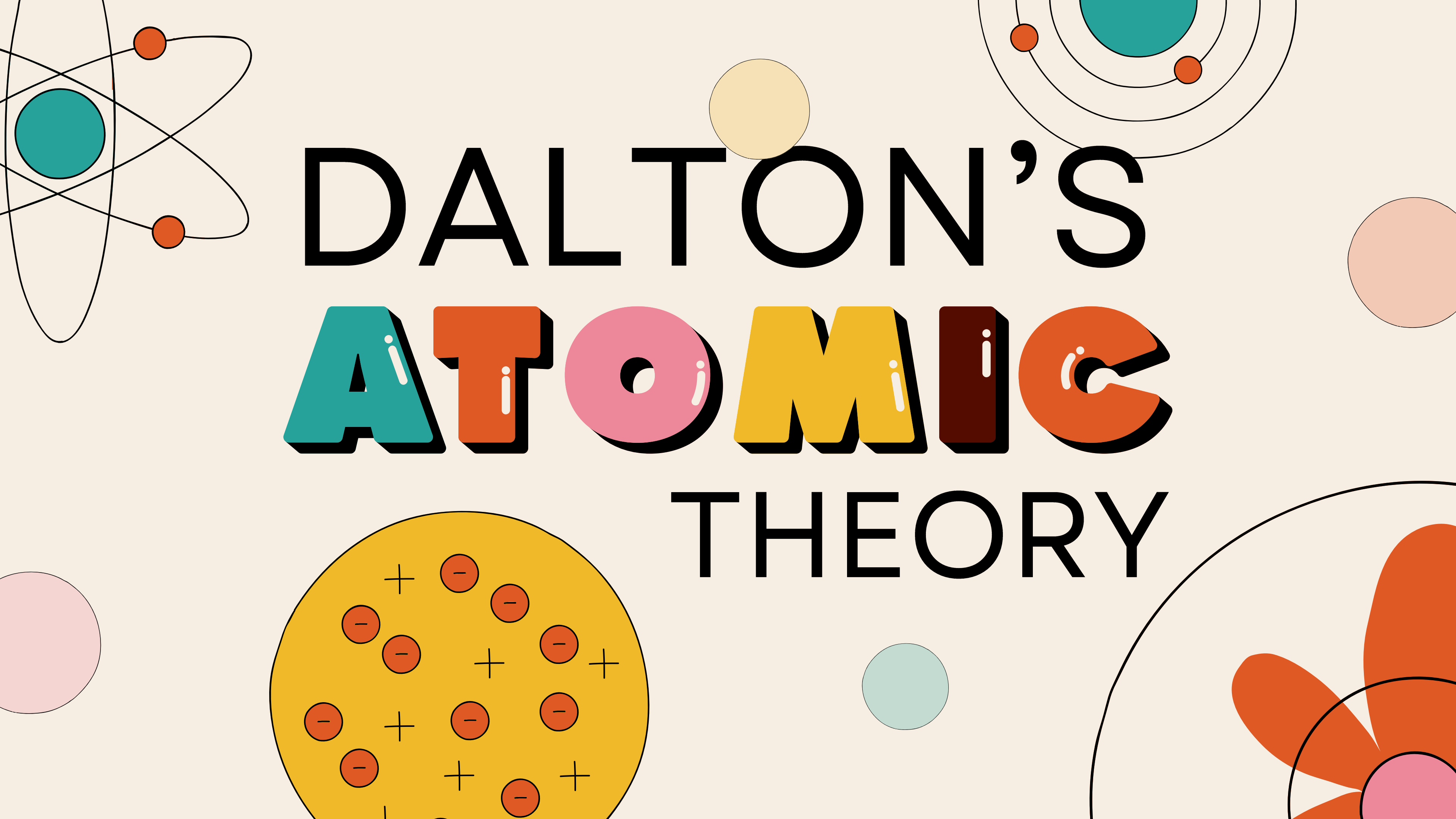
- They supposed these particles to be perfectly solid entities that came in various shapes and sizes but too small to be seen by the naked eye





ARISTOTLE

An influential philosopher who said that everything in the world was made of four fundamental elements: earth, air, fire, and water

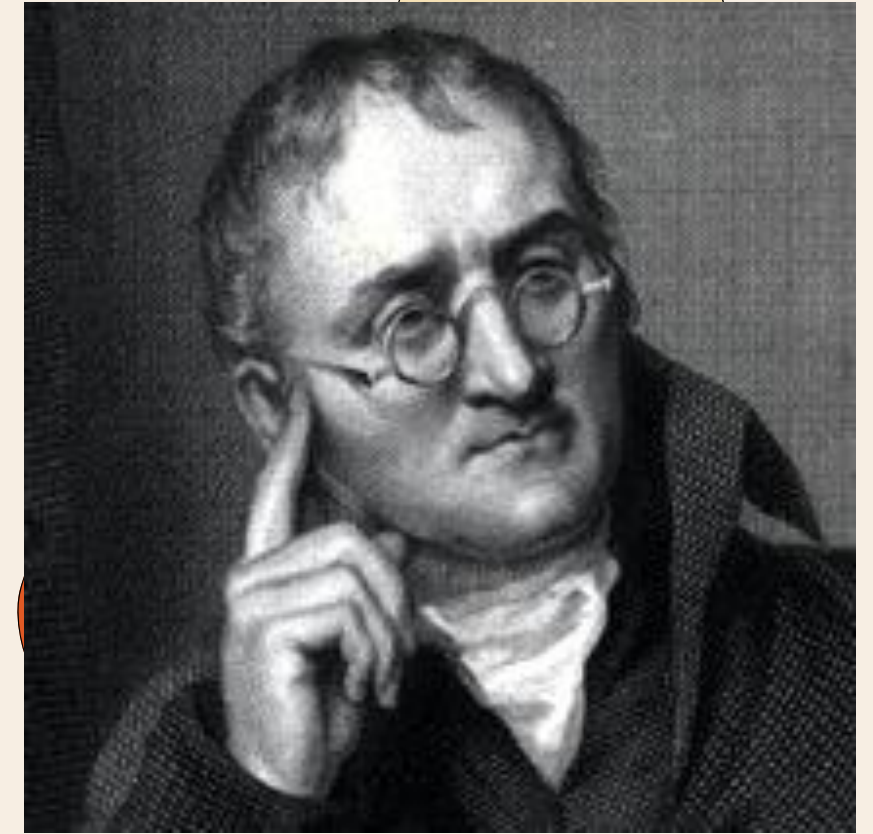
The background features several stylized atomic models and particles. In the top left, an atom with a teal nucleus and three orange electrons on elliptical orbits. In the top right, another atom with a teal nucleus and two orange electrons. A yellow sphere is positioned above the letter 'O' in 'DALTON'S'. A pink sphere is to the right of the word 'ATOMIC'. A large yellow sphere containing smaller orange spheres with minus signs and black plus signs is in the bottom left. A light blue sphere is in the bottom center. An orange flower-like shape with a pink center is in the bottom right. A pink sphere is on the far left.

DALTON'S ATOMIC THEORY



JOHN DALTON

1803



- **English chemist and physicist**
- **Proposed the atomic theory of matter**



POSTULATES



- 1 Matter is composed of very small, spherical, indivisible particles called atoms

A 3RD FLICK



Initiv 3RD FLIX

POSTULATES

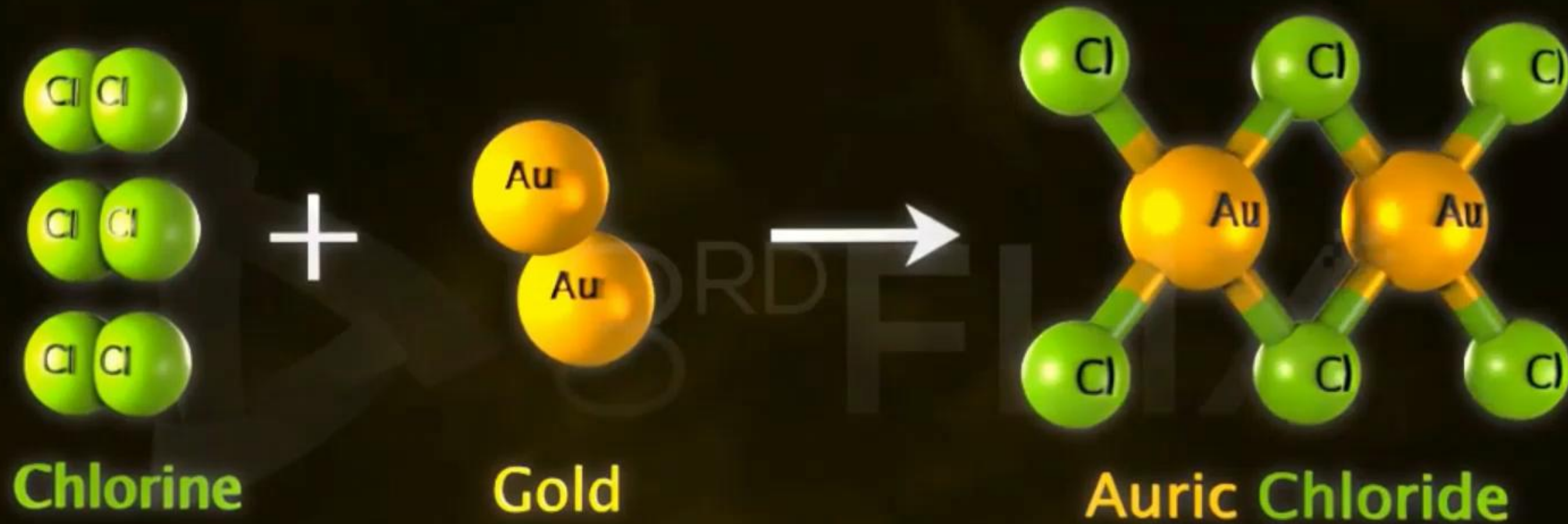
2



Every element is represented by a unique atom. Atoms of the same element have identical properties, shape, and mass, while atoms of different elements have different properties, shape and mass.



CASE 2



Atoms of an element identical in size, shape and mass, they also possess the same chemical properties.

POSTULATES



- 3 Atoms chemically combine in simple, fixed, whole number ratios to form compounds.



Zinc

Hydrochloric Acid

Zinc Chloride

Hydrogen

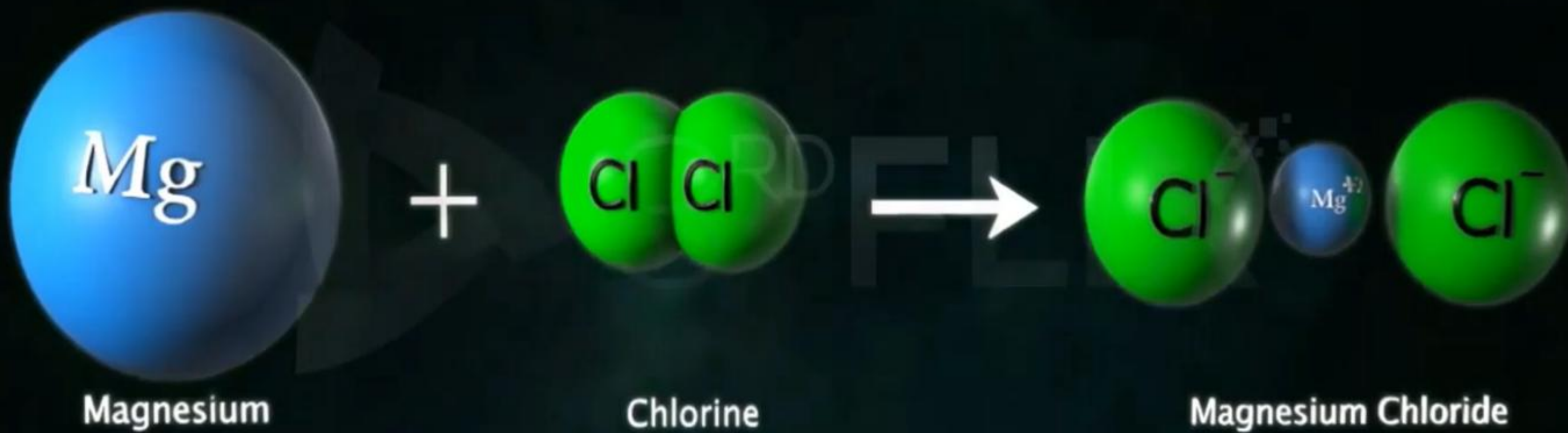
Atoms are neither created nor destroyed in a chemical reaction.

POSTULATES

4

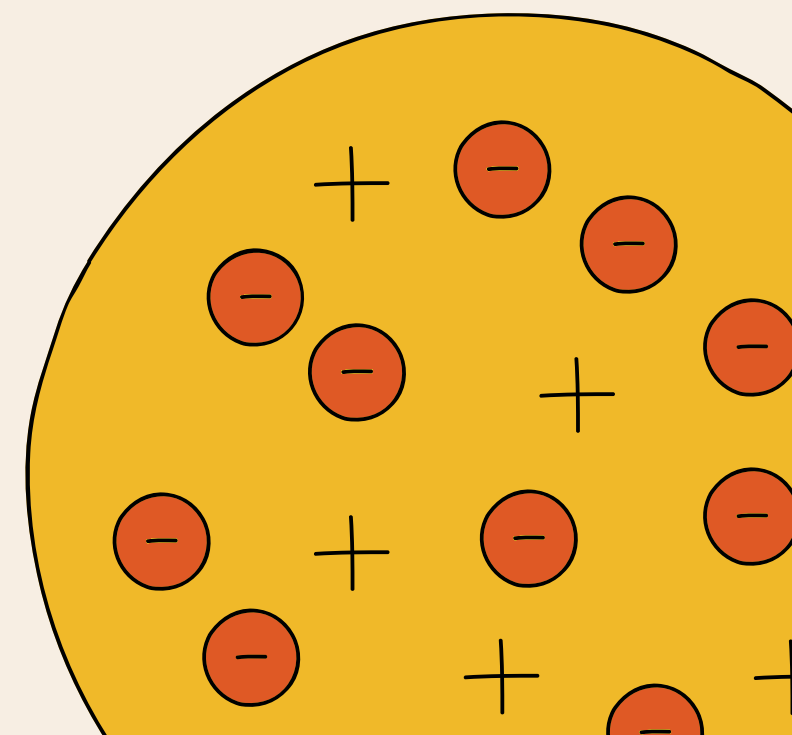
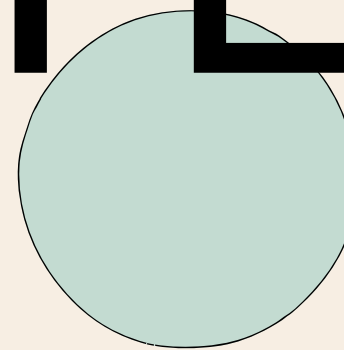
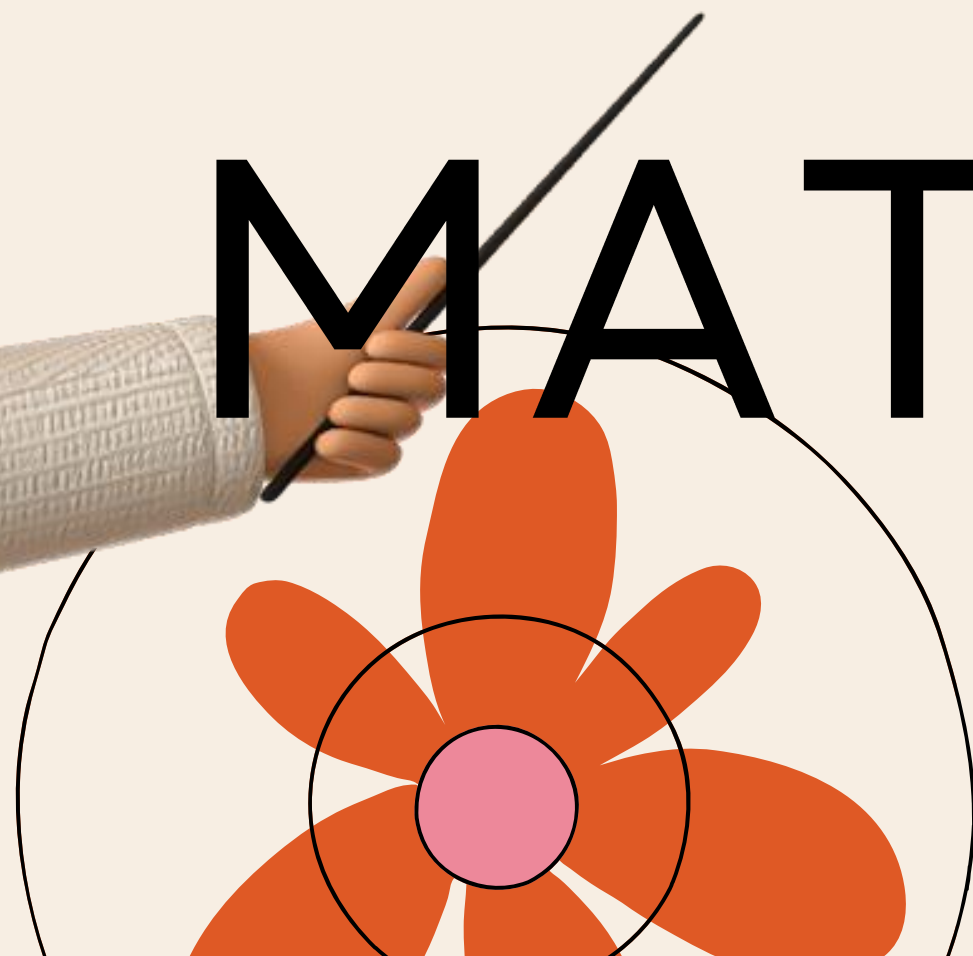


During chemical reaction, atoms in compounds rearrange to form new substances. However, none of the individual atoms are destroyed or transformed into an atom of a different element and no new atom is created.



Further atom is considered as the smallest particle that takes part in a chemical reaction.

FUNDAMENTAL LAWS OF MATTER



LAW OF CONSERVATION OF MASS



- (1789) first proposed by French chemist Antoine Lavoisier



LAW OF CONSERVATION OF MASS

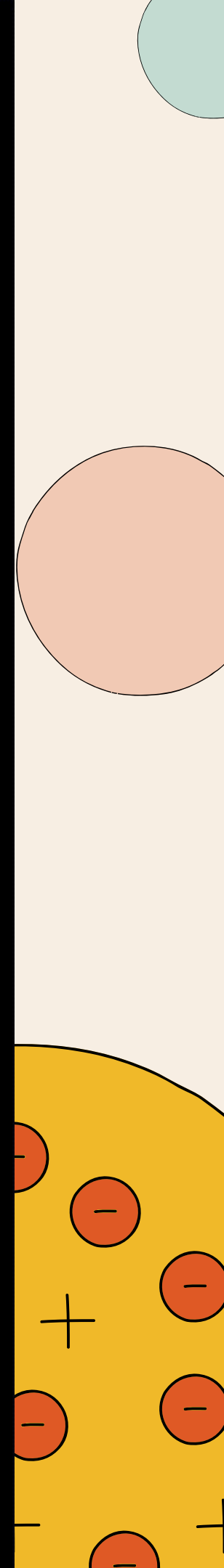


- States that the total mass of a closed system (substances undergoing physical transformations or chemical reactions) remains constant

LAW OF CONSERVATION OF MASS



- means that matter is neither created nor destroyed during physical or chemical changes



LAW OF DEFINITE PROPORTIONS

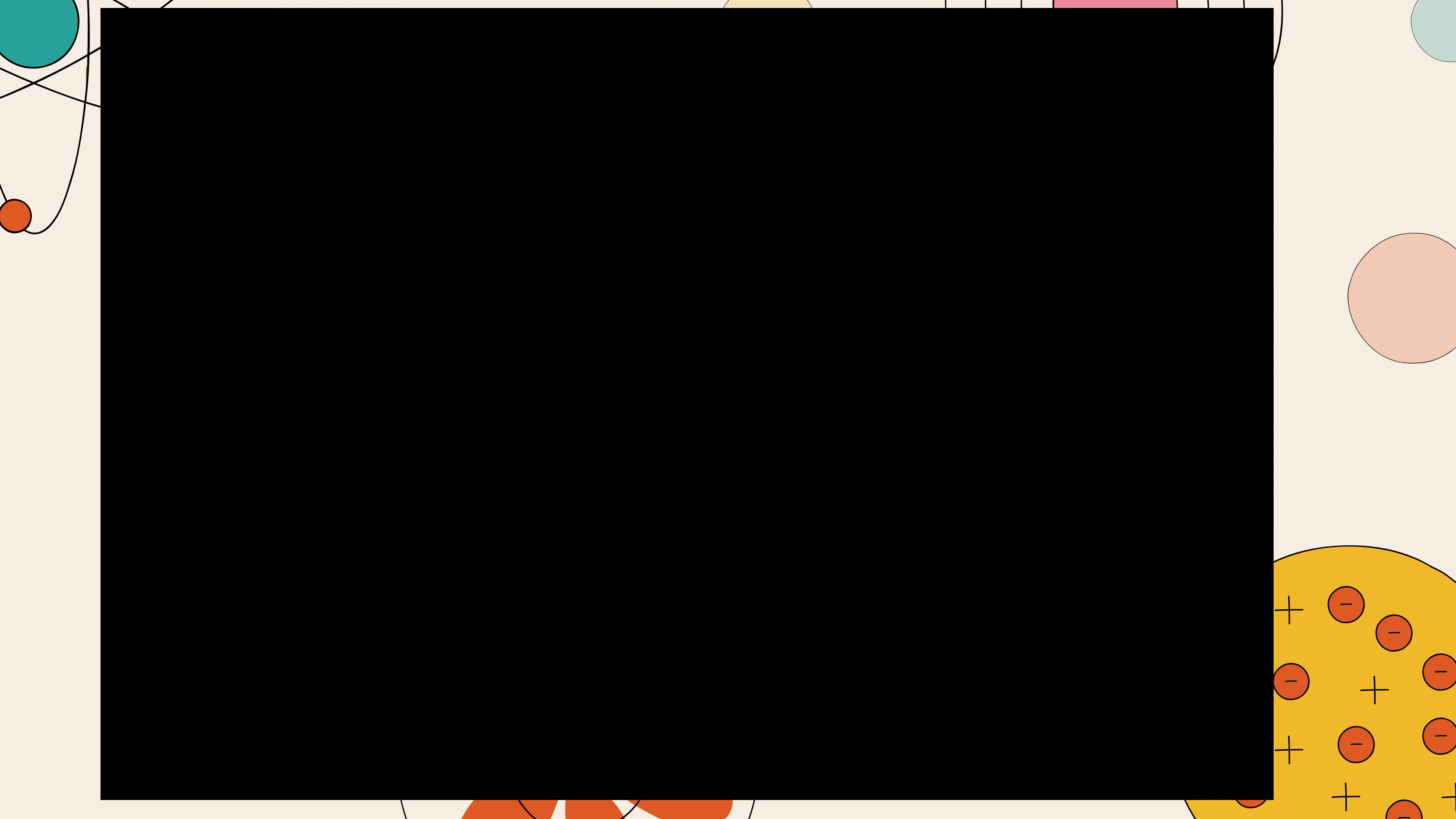
- (1794) formulated by French chemist Joseph-Louis Proust

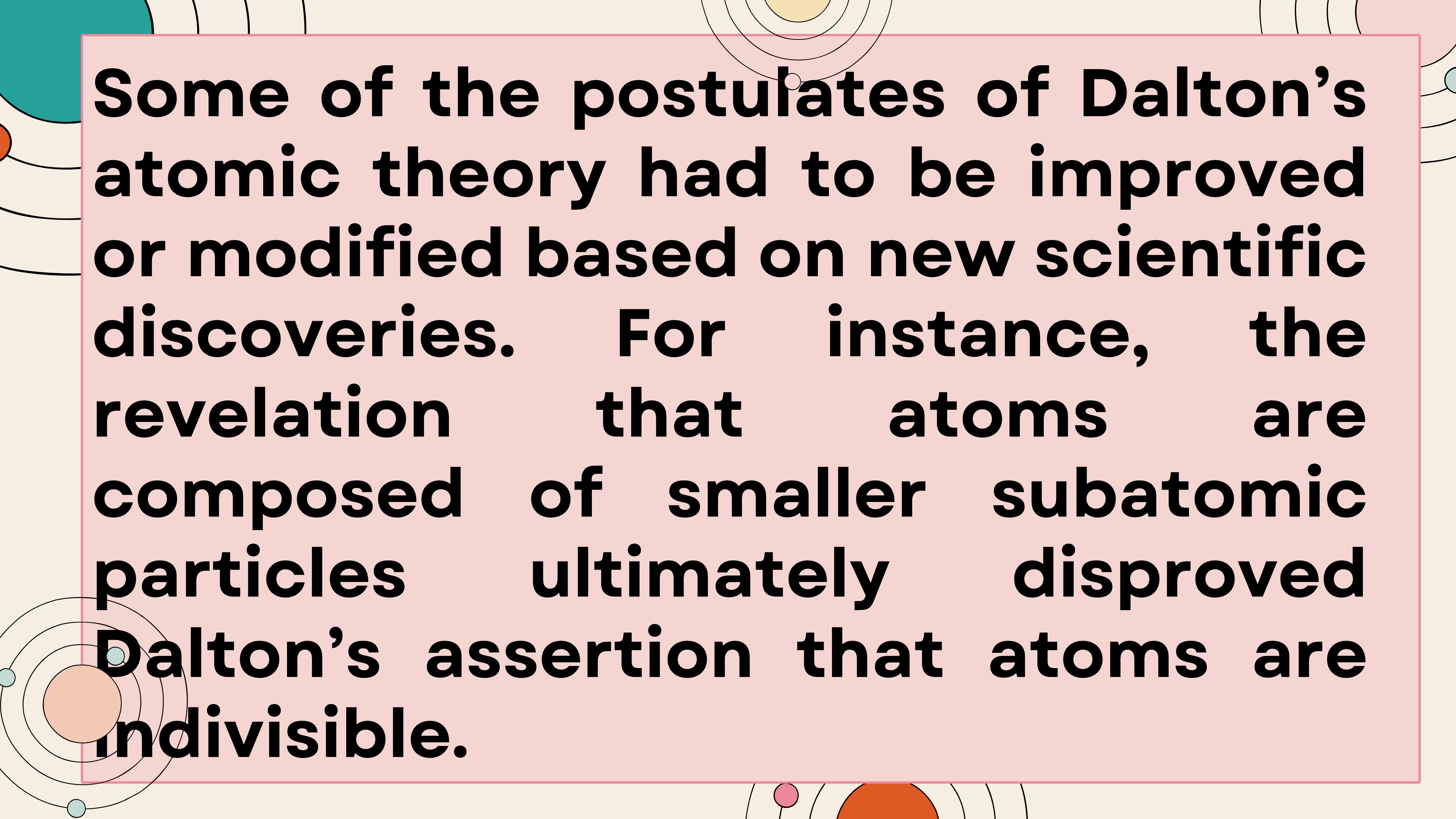


LAW OF DEFINITE PROPORTIONS

- states that a compound always contains the same elements regardless of the source

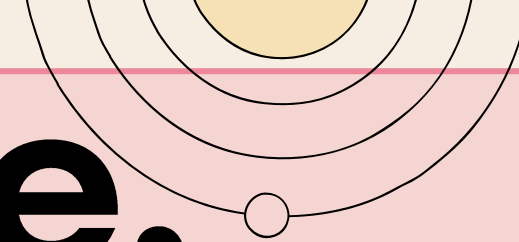
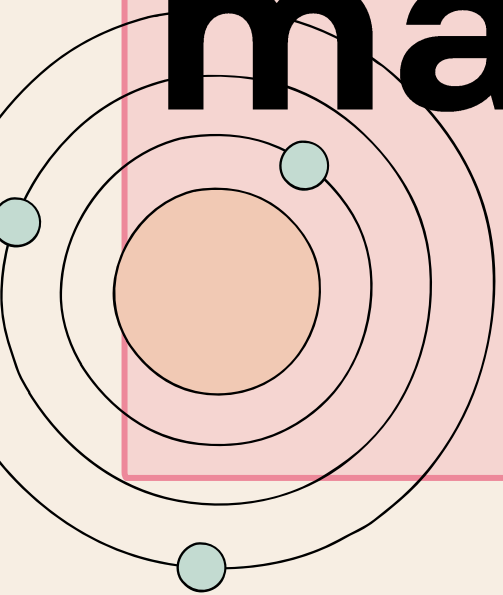


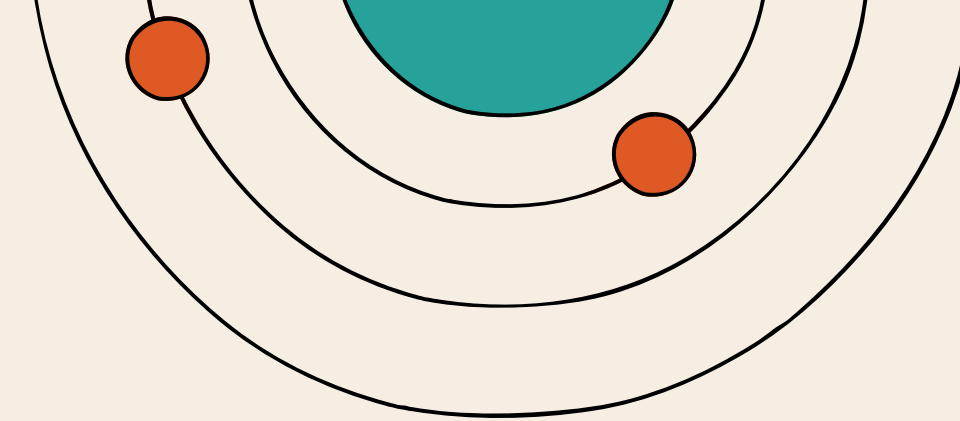
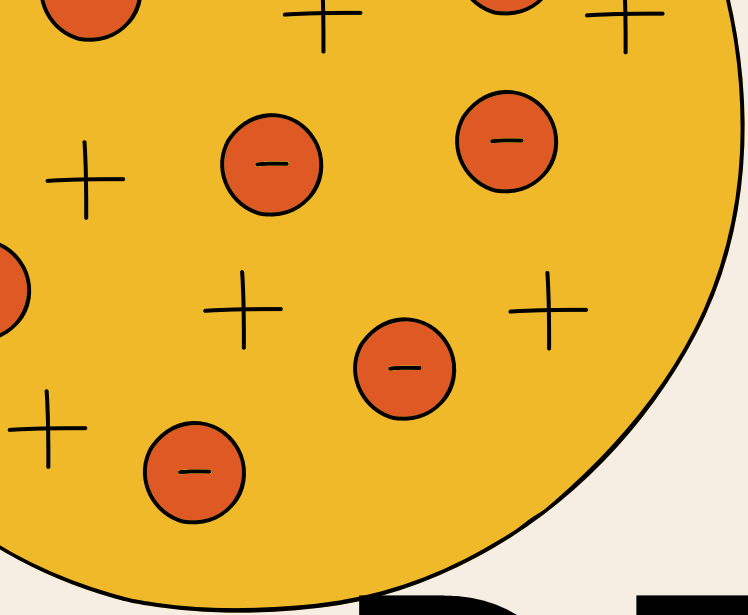


The background features several stylized atomic models. One model at the top center has a yellow nucleus and three concentric circles representing electron shells. Another model at the bottom left has an orange nucleus and three concentric circles with small blue dots representing electrons. A third model at the bottom right has an orange nucleus and a single pink dot representing an electron. The text is centered within a light pink rectangular box.

Some of the postulates of Dalton's atomic theory had to be improved or modified based on new scientific discoveries. For instance, the revelation that atoms are composed of smaller subatomic particles ultimately disproved Dalton's assertion that atoms are indivisible.

Furthermore, the discovery of isotopes challenged the notion that atoms of the same element always have identical masses.

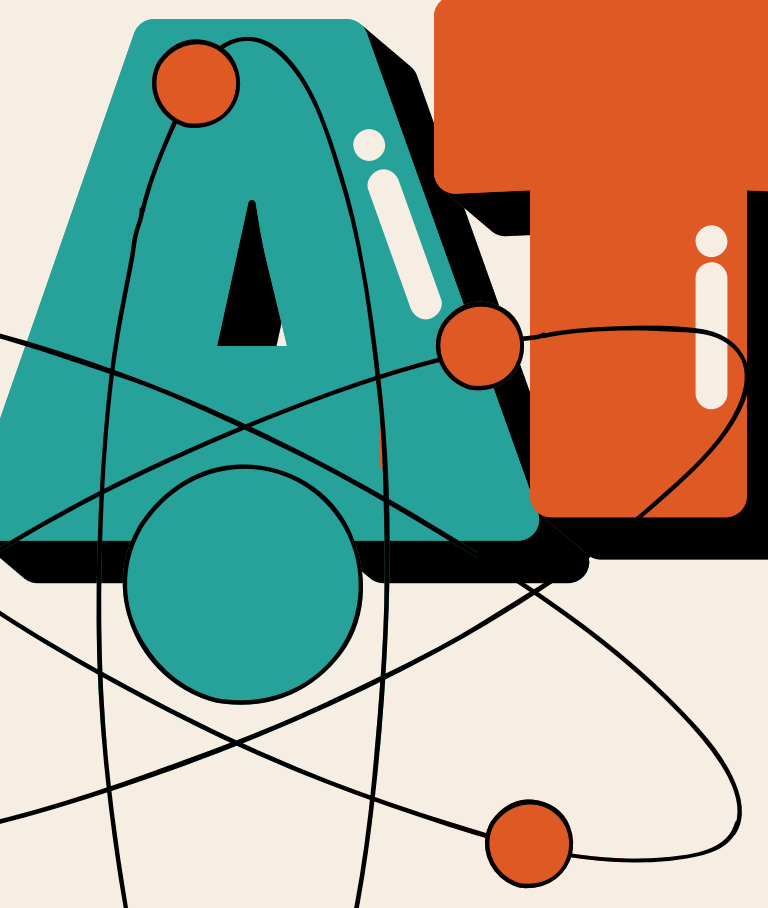




LESSON 2

DEVELOPMENT OF THE MODERN

ATOMS

A diagram of an orbital model of an atom, showing a central blue nucleus and three elliptical orbits with red electrons.

MODEL



LEARNING OBJECTIVES



- 1 Draw the atom and define its properties according to the atomic models proposed by Thomson, Rutherford, Bohr, and Schrodinger
- 2 Trace the timeline and discuss key scientific discoveries that propelled the evolution of the modern atomic theory, from Dalton's postulates to the quantum mechanical model



1

Solid Sphere Model

2

Plum Pudding Model

3

Nuclear Model

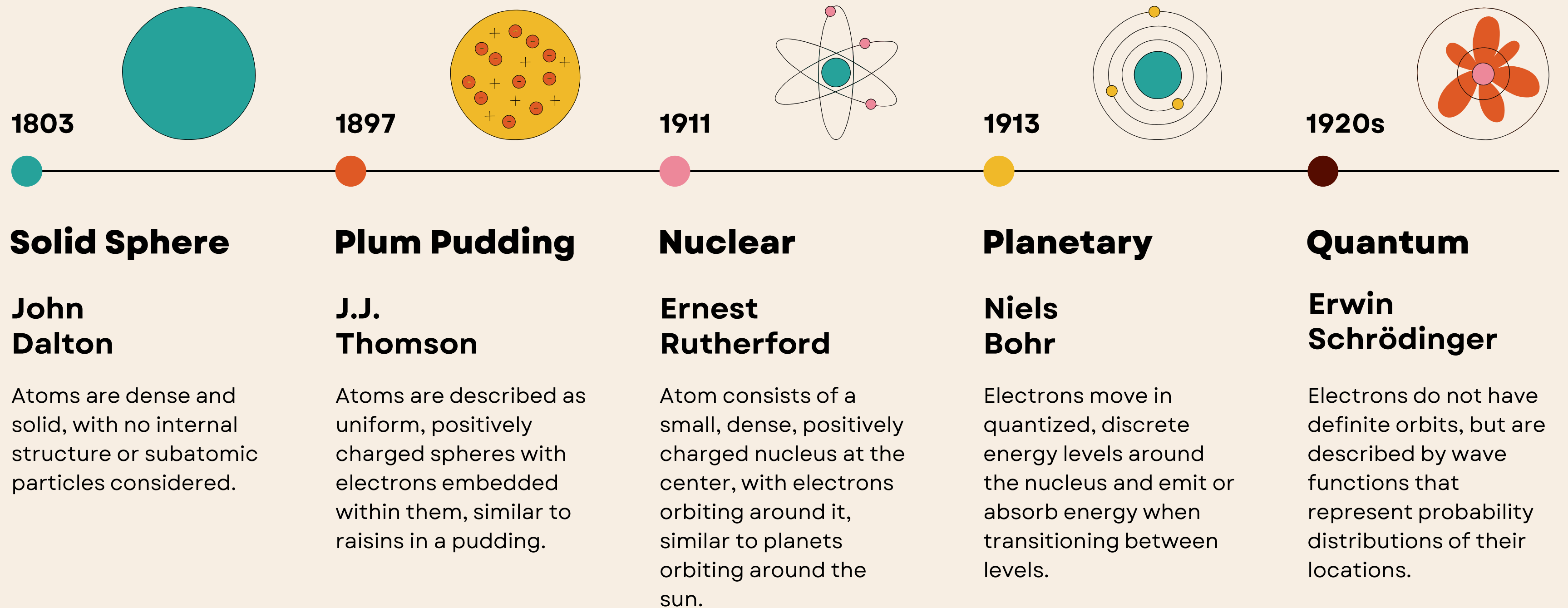
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Planetary Model

5

Quantum Model

ATOMIC THEORY TIMELINE





SOLID SPHERE MODEL

ATOMIC THEORY

1803

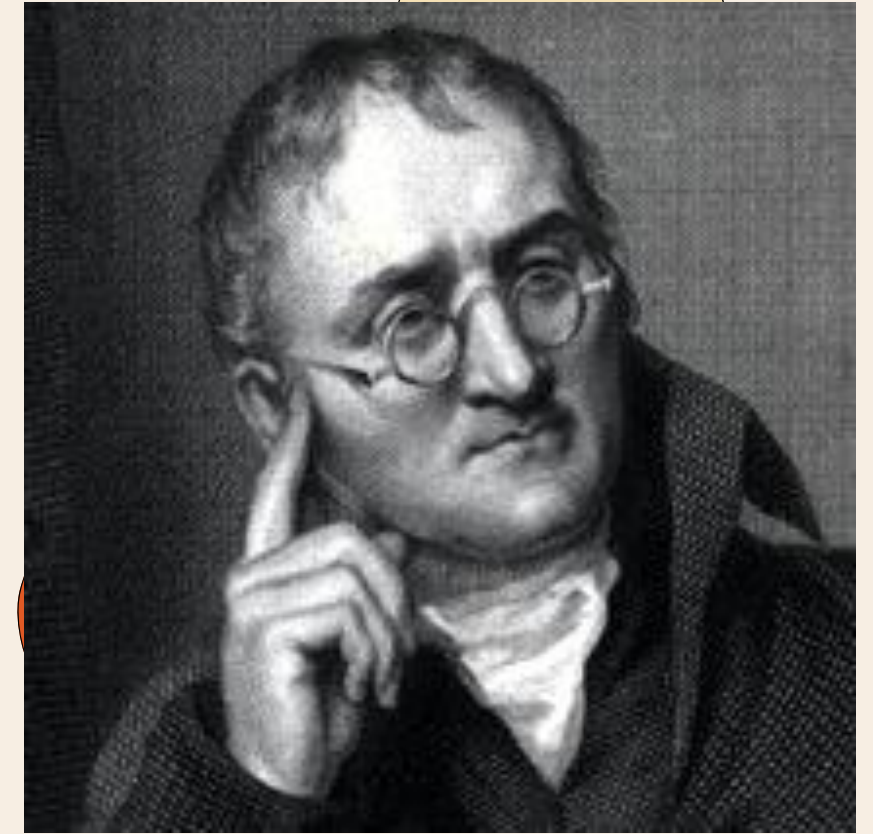
According to this theory, atoms are spherical/tiny indivisible spheres



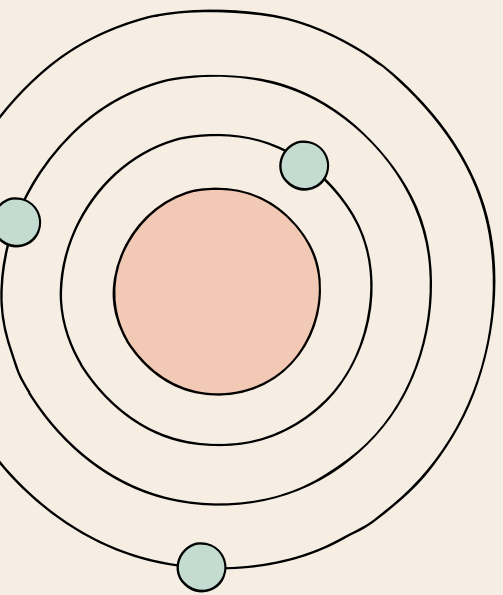
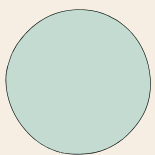
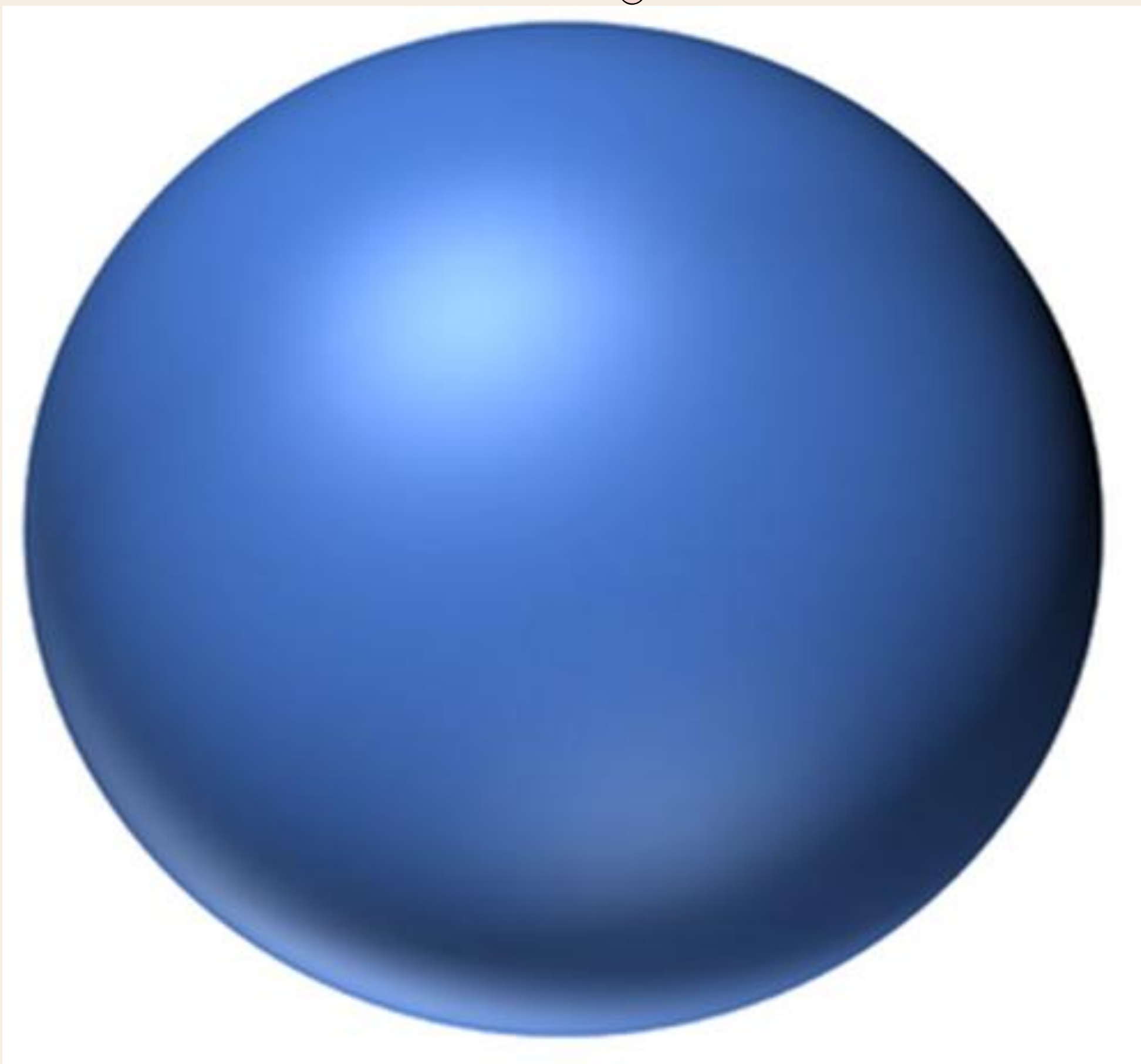
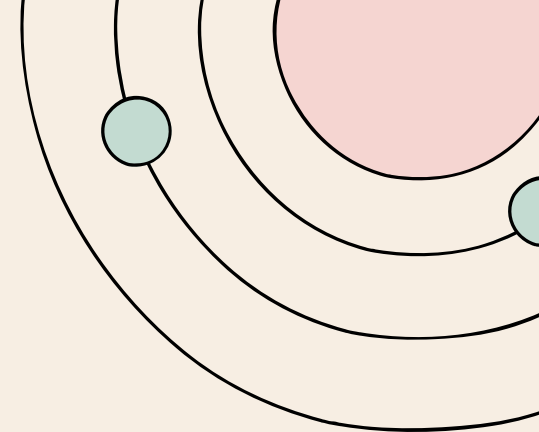
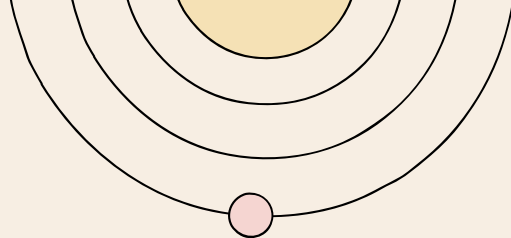
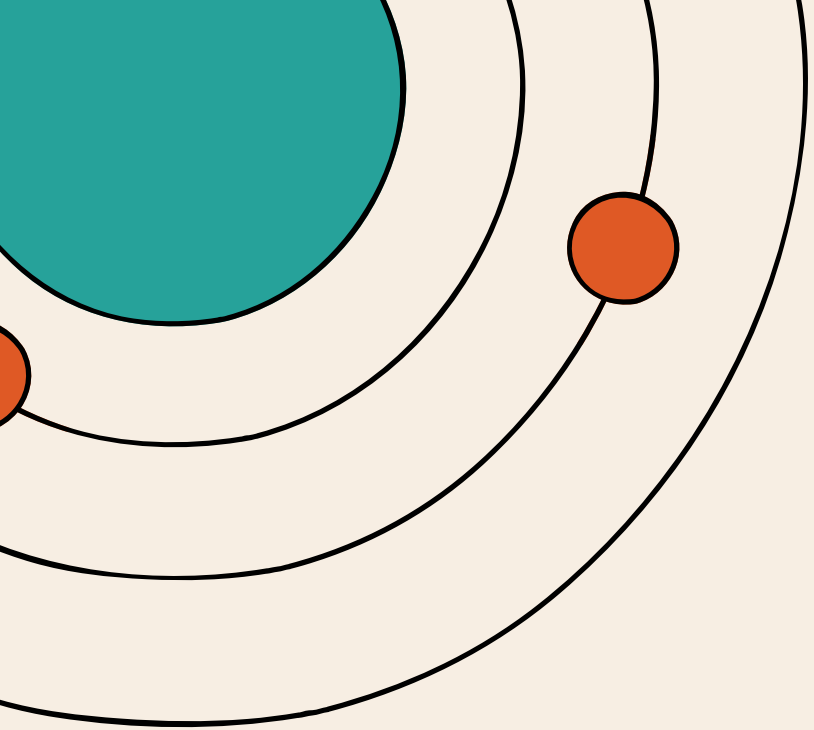


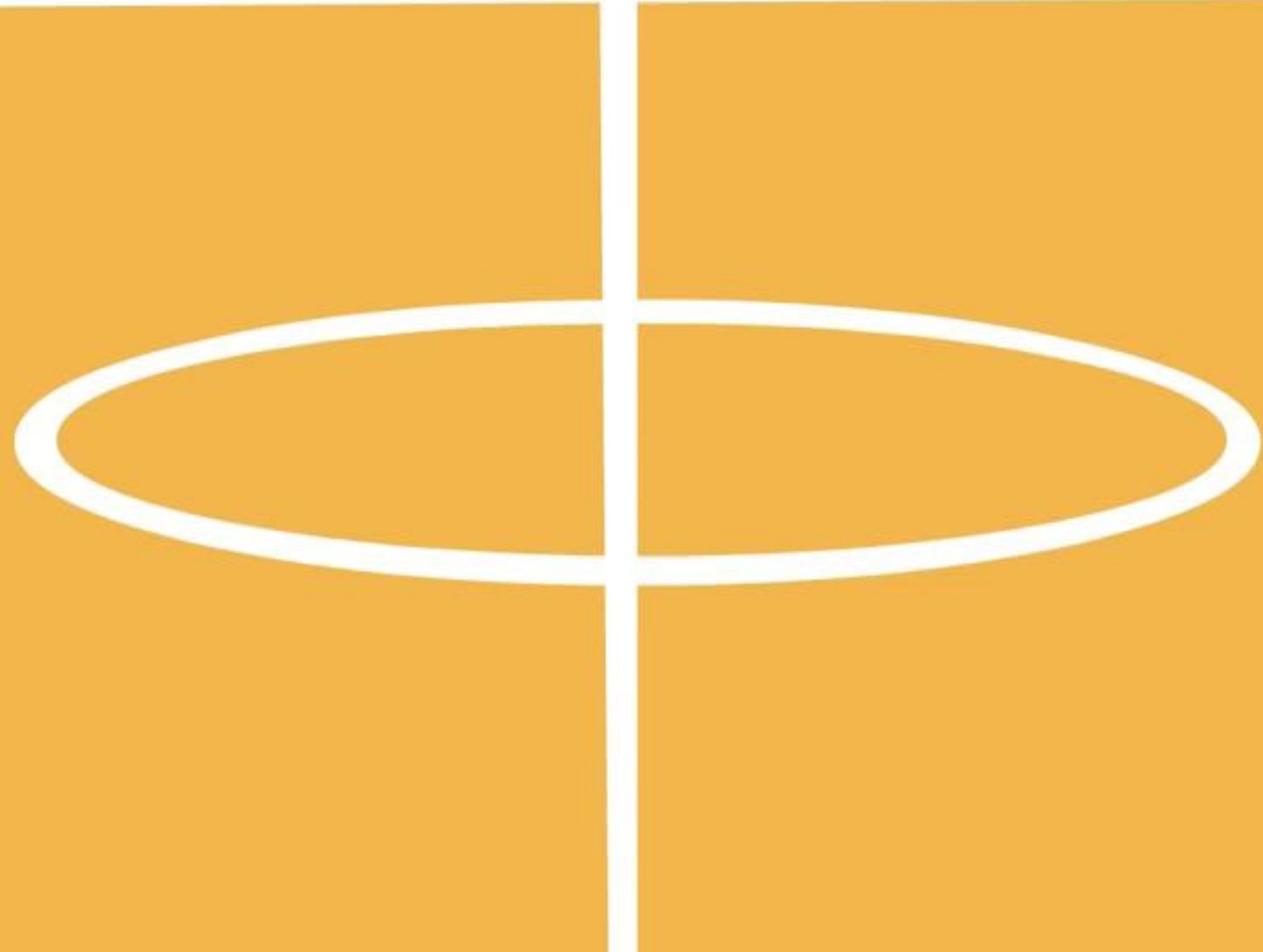
JOHN DALTON

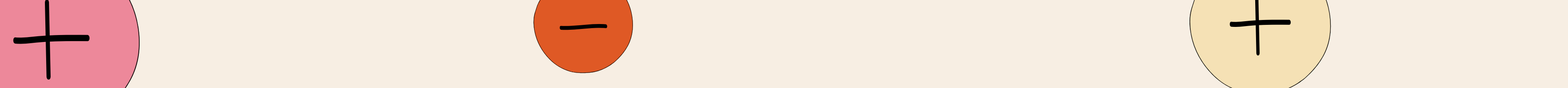
1803



- **Proposed the Solid Sphere Model**







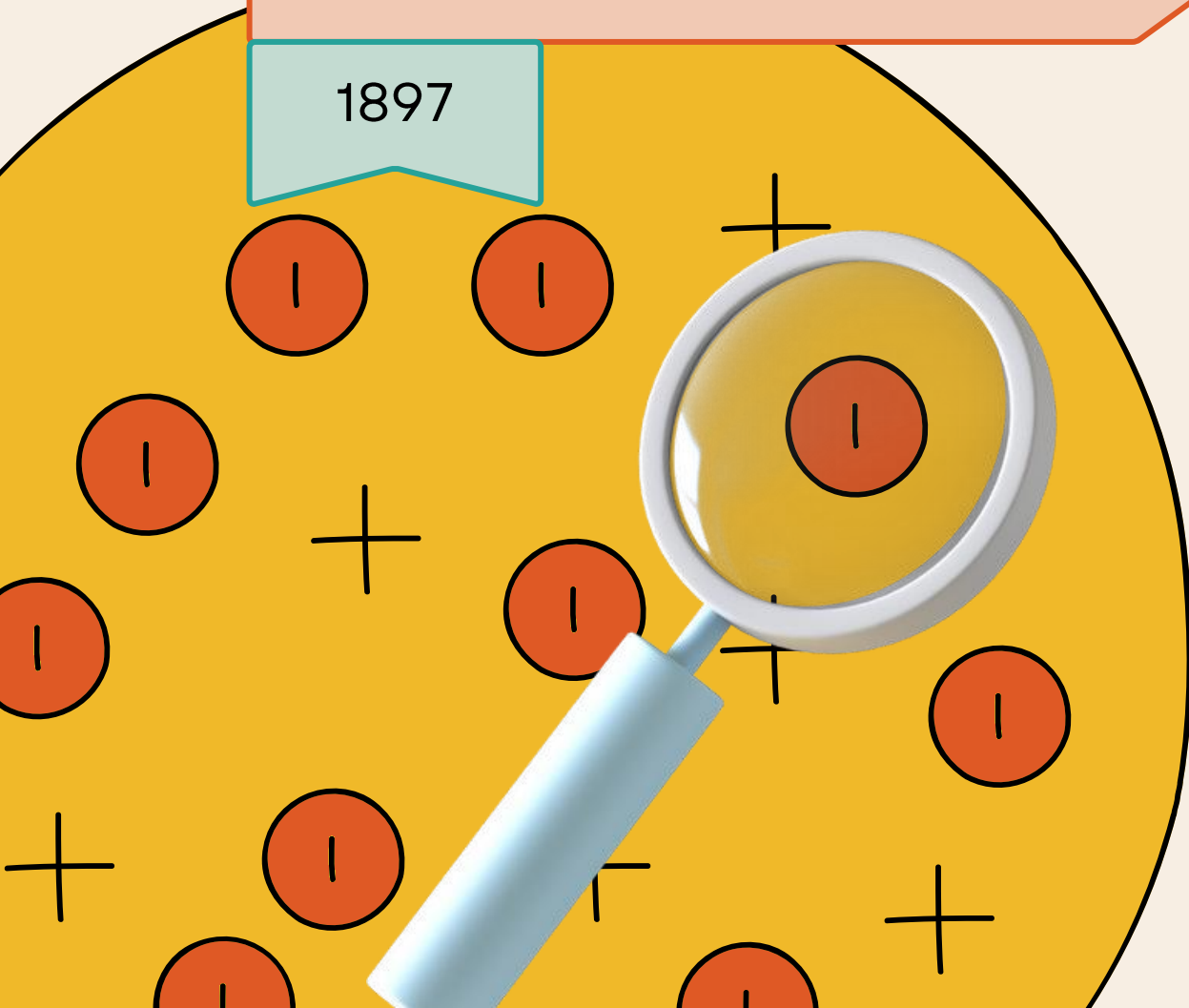
PLUM PUDDING MODEL

ATOMIC THEORY

1897

According to this theory, atom is a neutral entity composed of a positive blob embedded with electrons

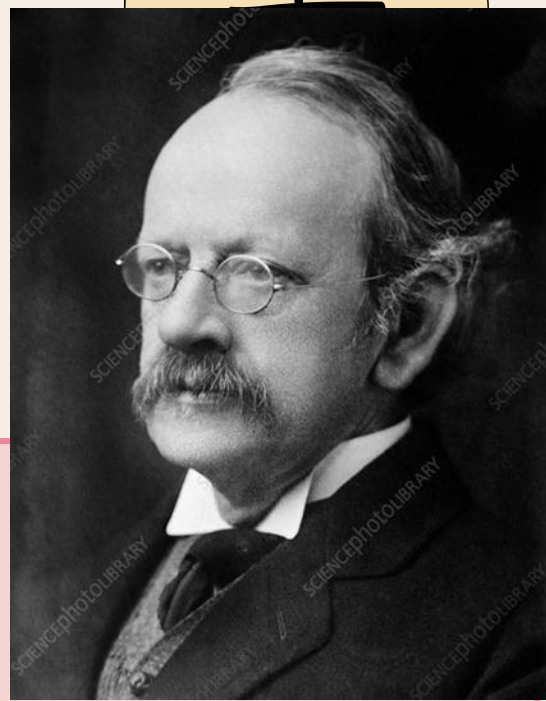
A result of the discovery of negatively charged particles inside the atom



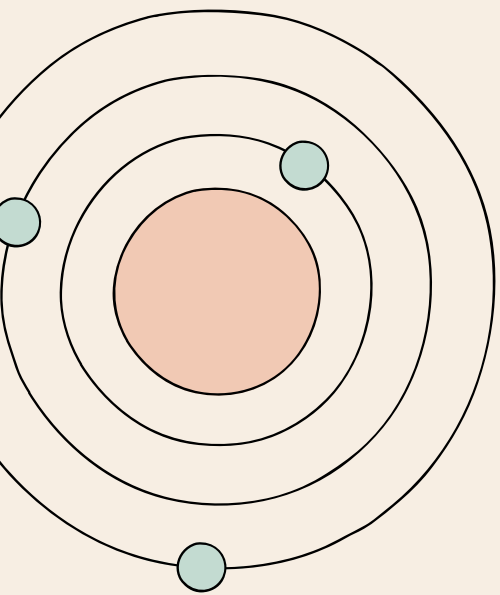
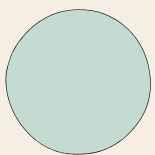
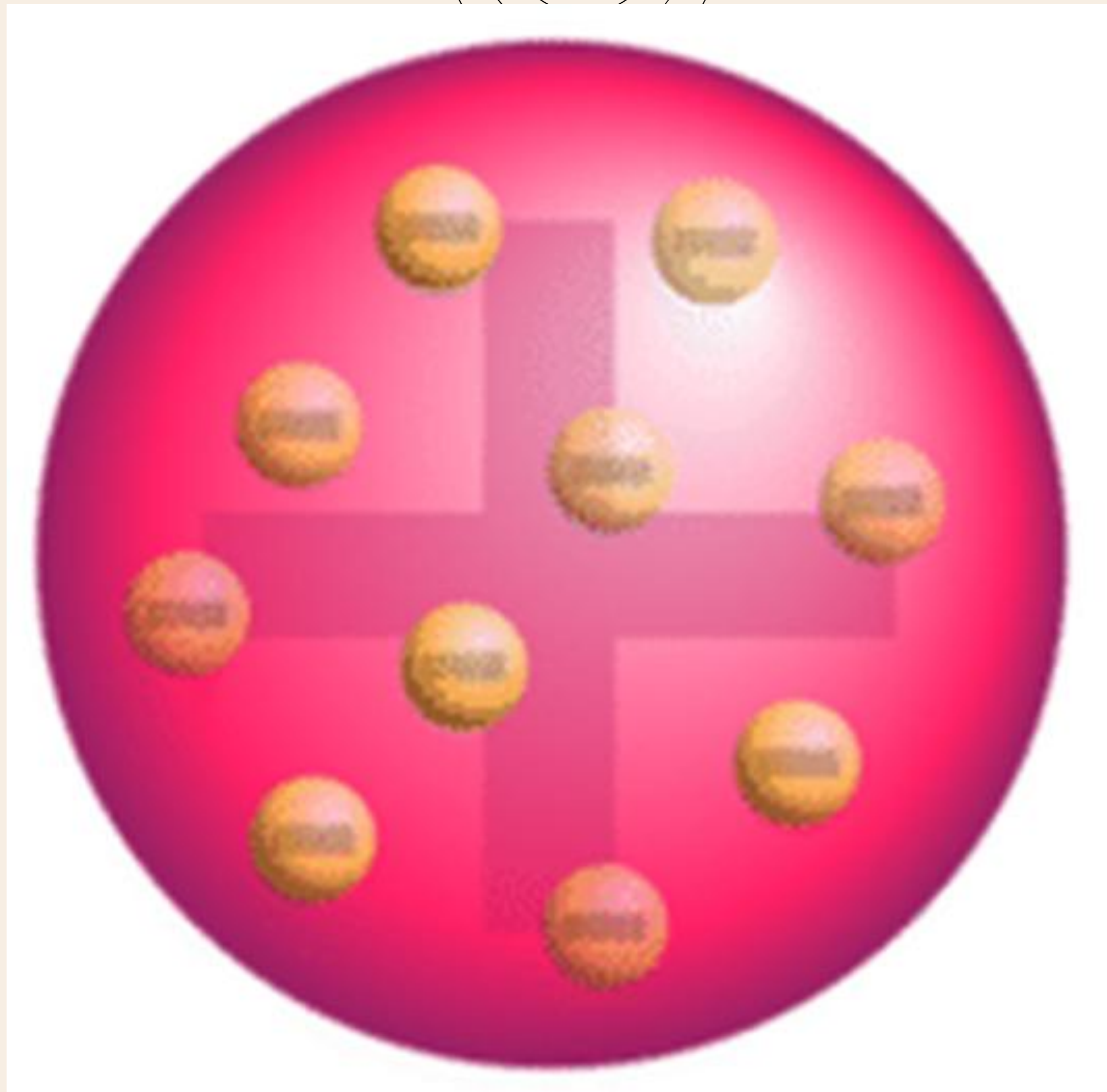
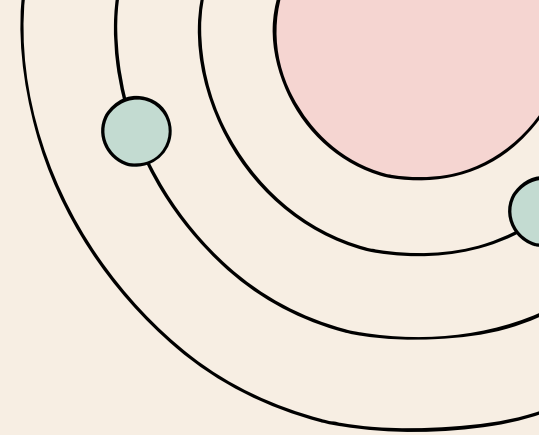
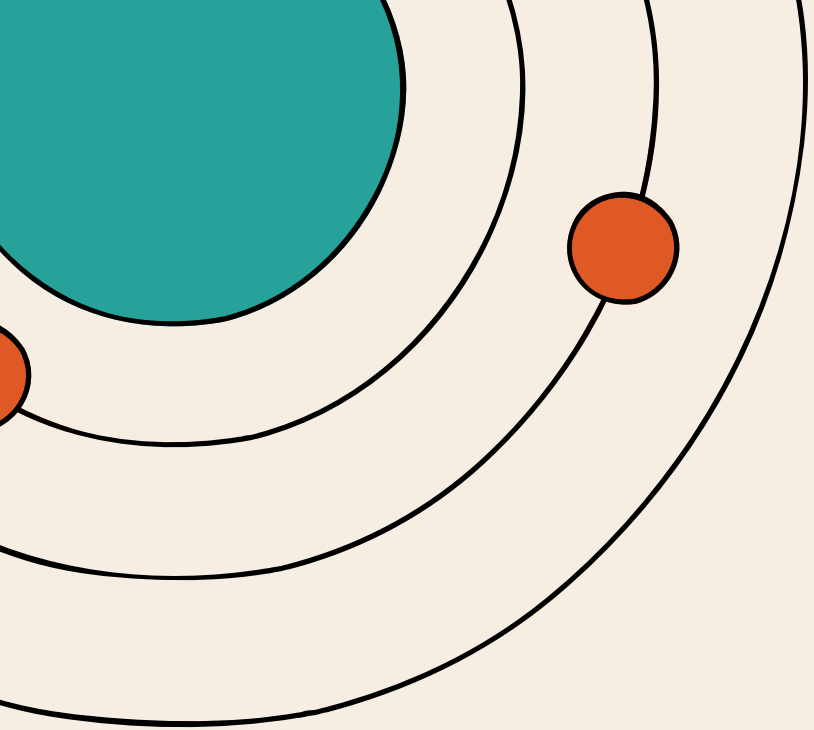


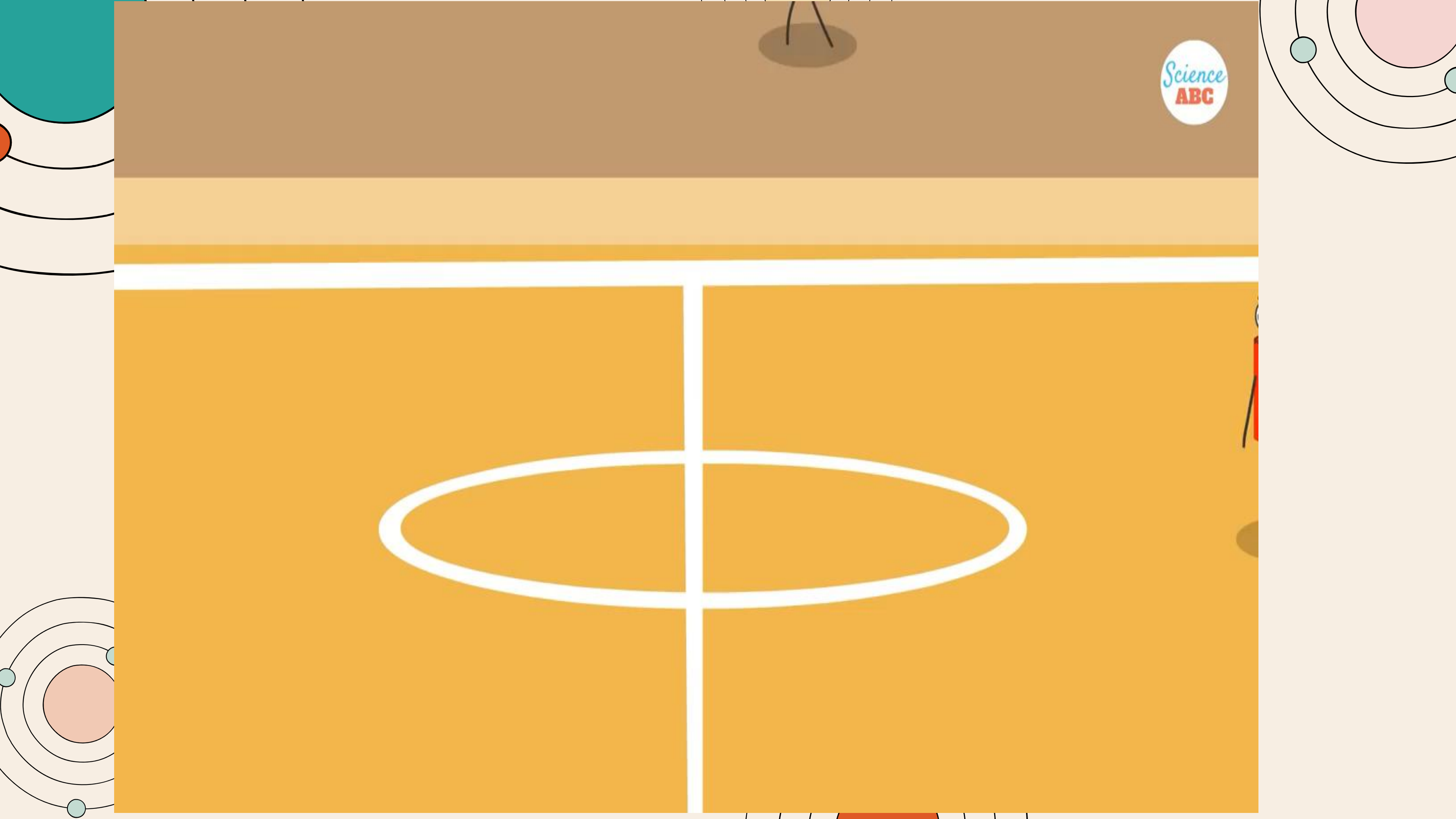
J.J. THOMSON

1856 - 1940



- British physicist who first described the negatively charged subatomic particles in 1897 through his experiments on cathode ray tubes and were later referred to as electrons, term previously coined by George Johnstone Stoney in 1891

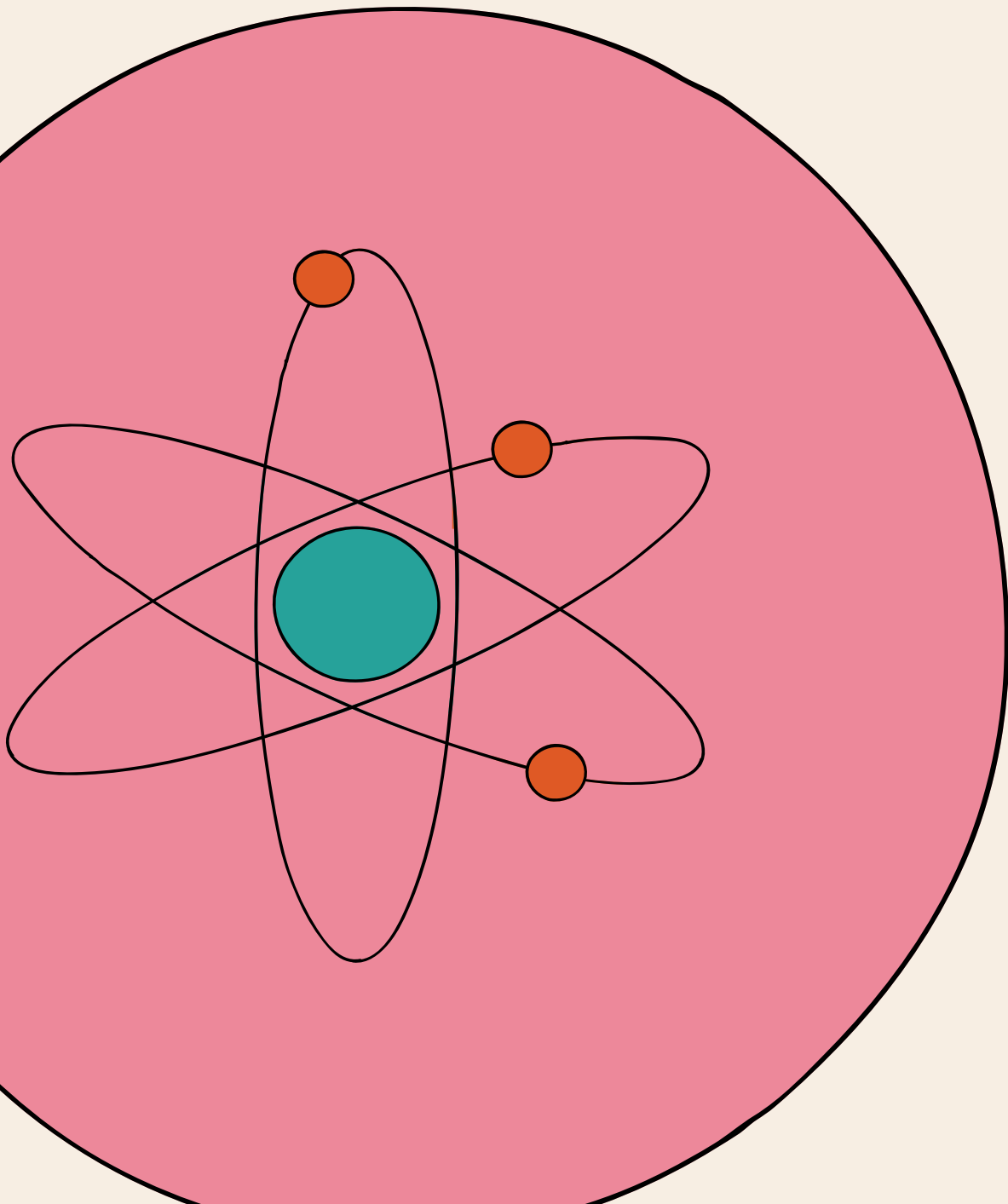




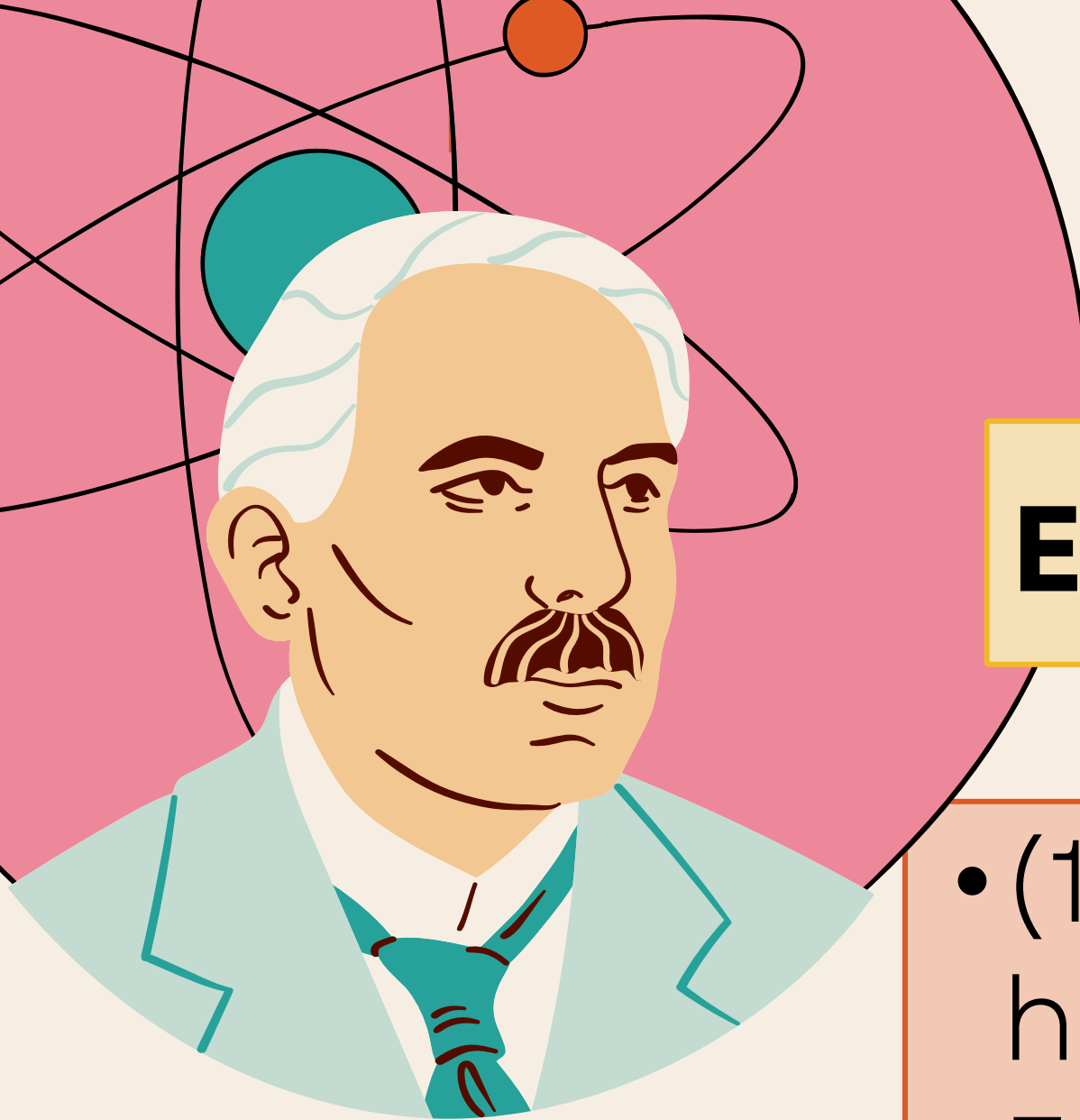
NUCLEAR MODEL

ATOMIC THEORY

1911

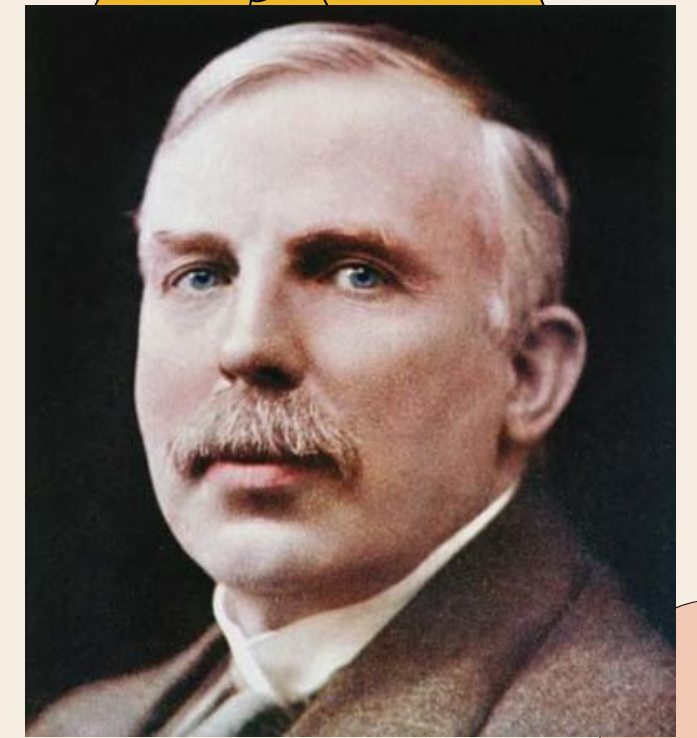


According to this theory, The atom is an entity comprising of mostly empty space, with a very dense nucleus where the mass and positive charge of the atom are concentrated. The electrons moved about and surrounded the nucleus

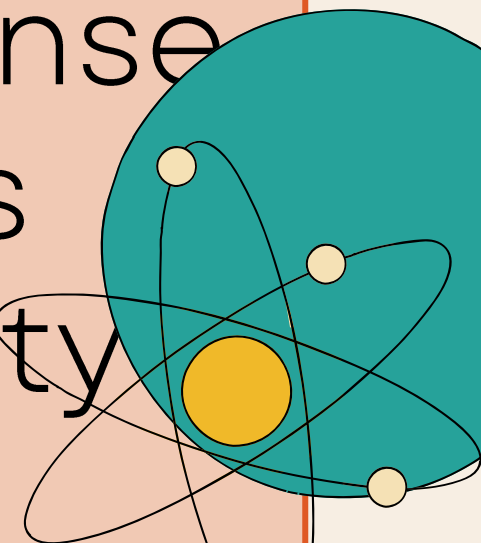
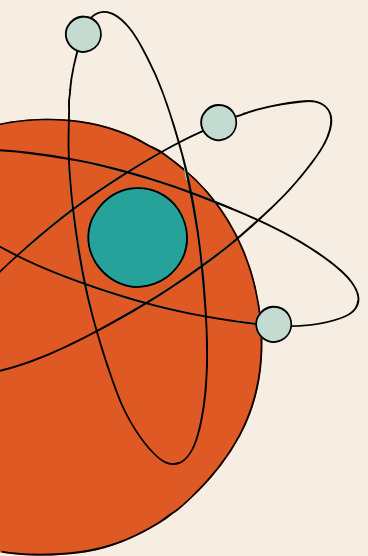


ERNEST RUTHERFORD

1871 - 1937



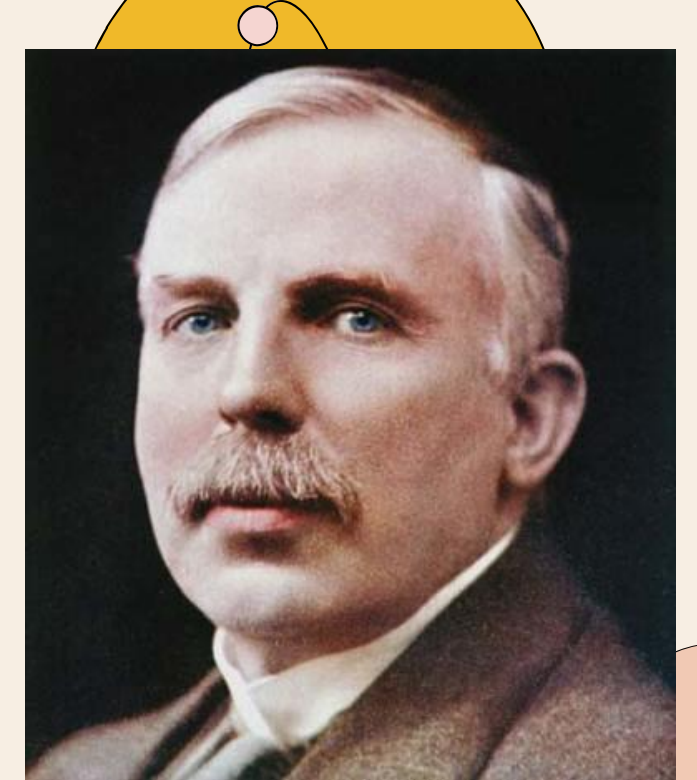
- (1909) a British physicist, along with his coworkers, Hans Geiger and Ernest Marsden, conducted the gold foil experiment which led to hypothesize the existence of a dense positively charged atomic nucleus that is surrounded by mostly empty space.



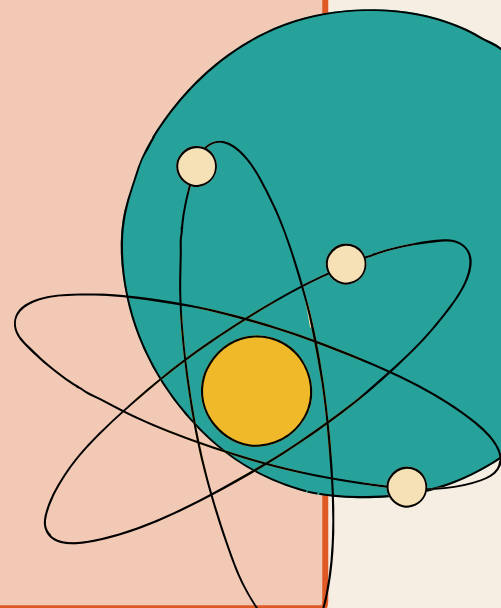
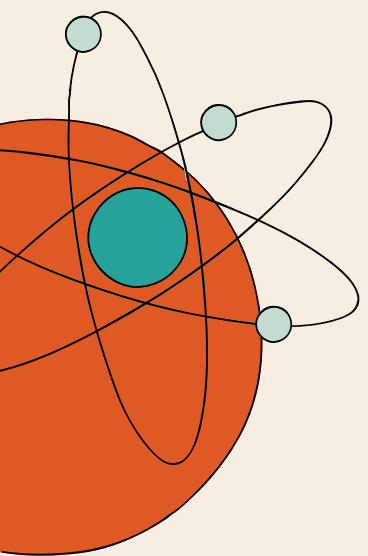


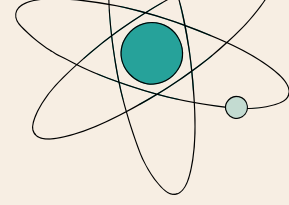
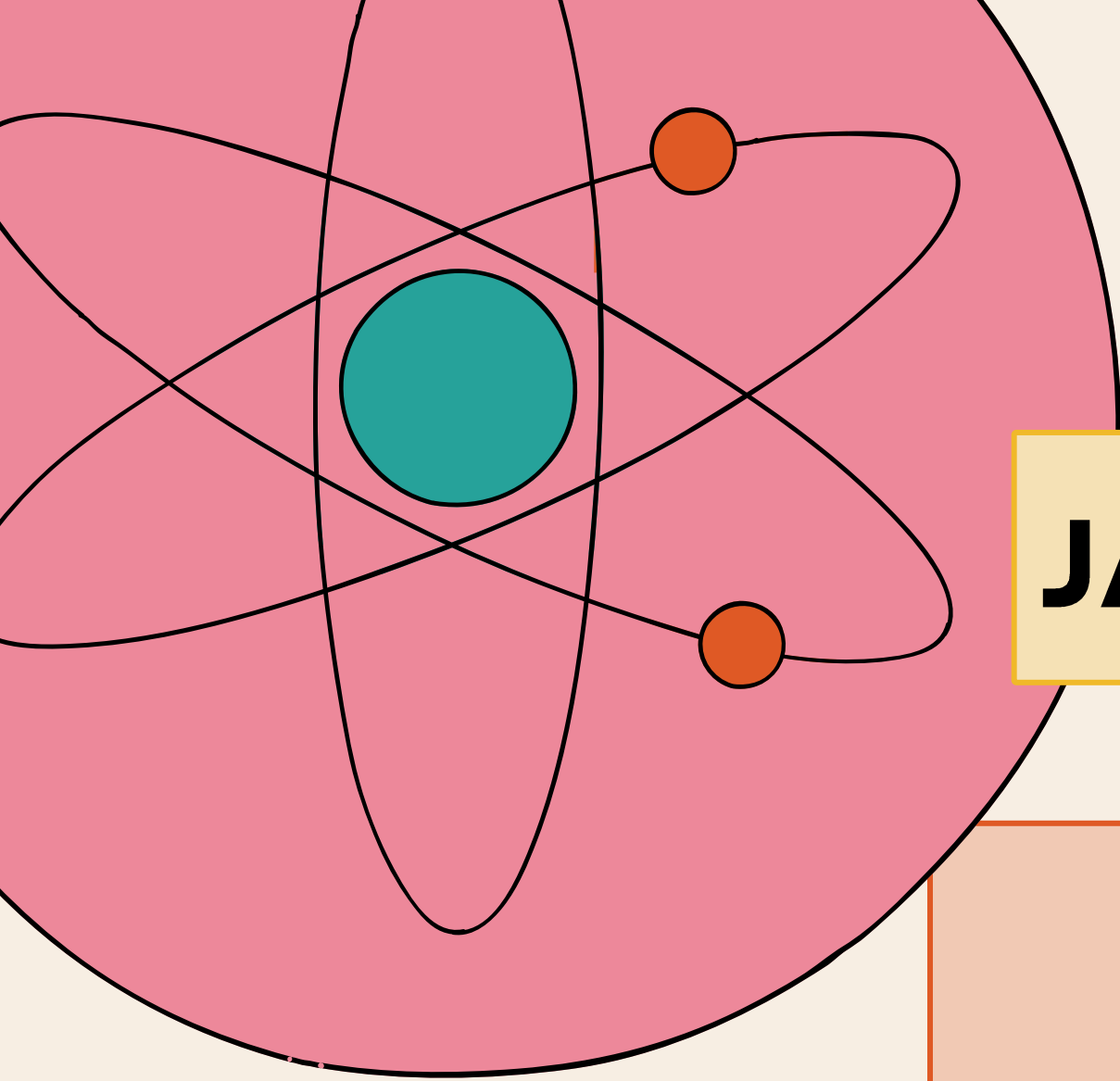
ERNEST RUTHERFORD

1871 - 1937

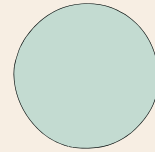
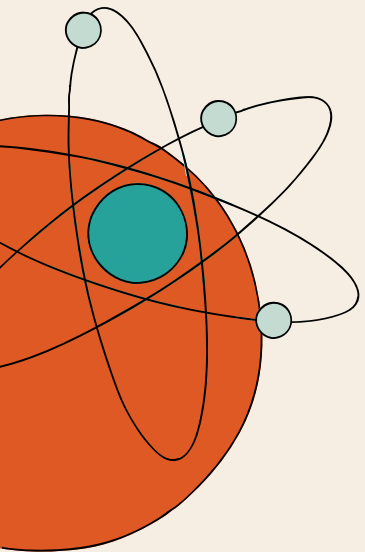
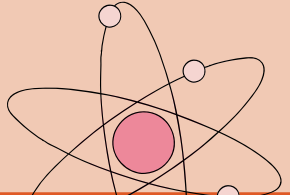
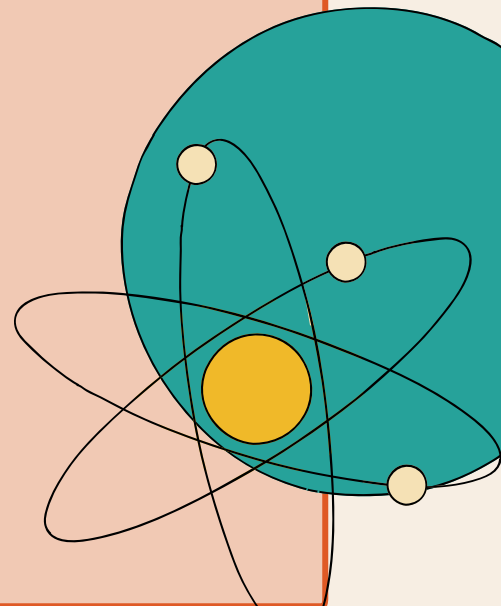


- He also later identify positively charged subatomic particles in the atom's nucleus and name them protons

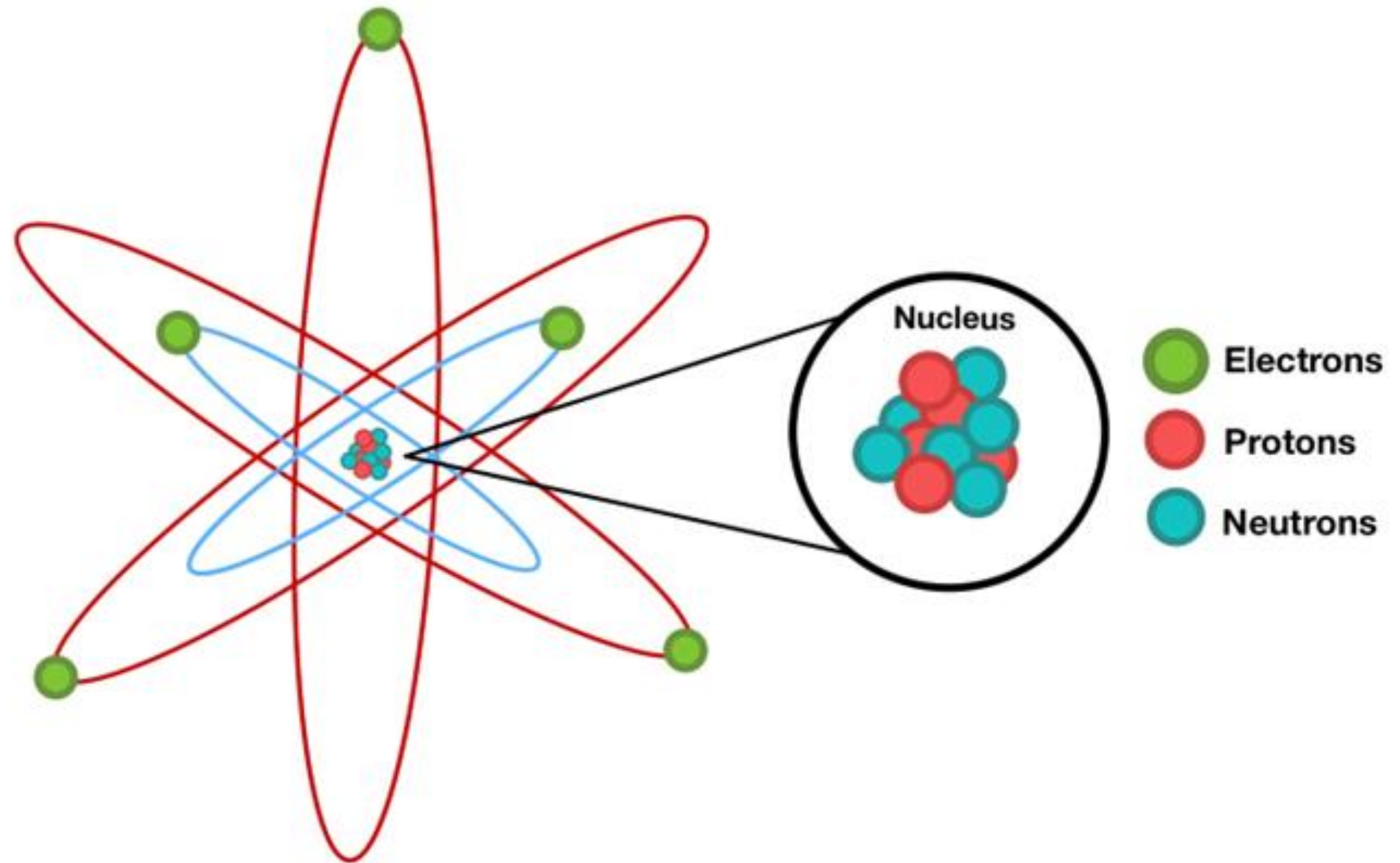


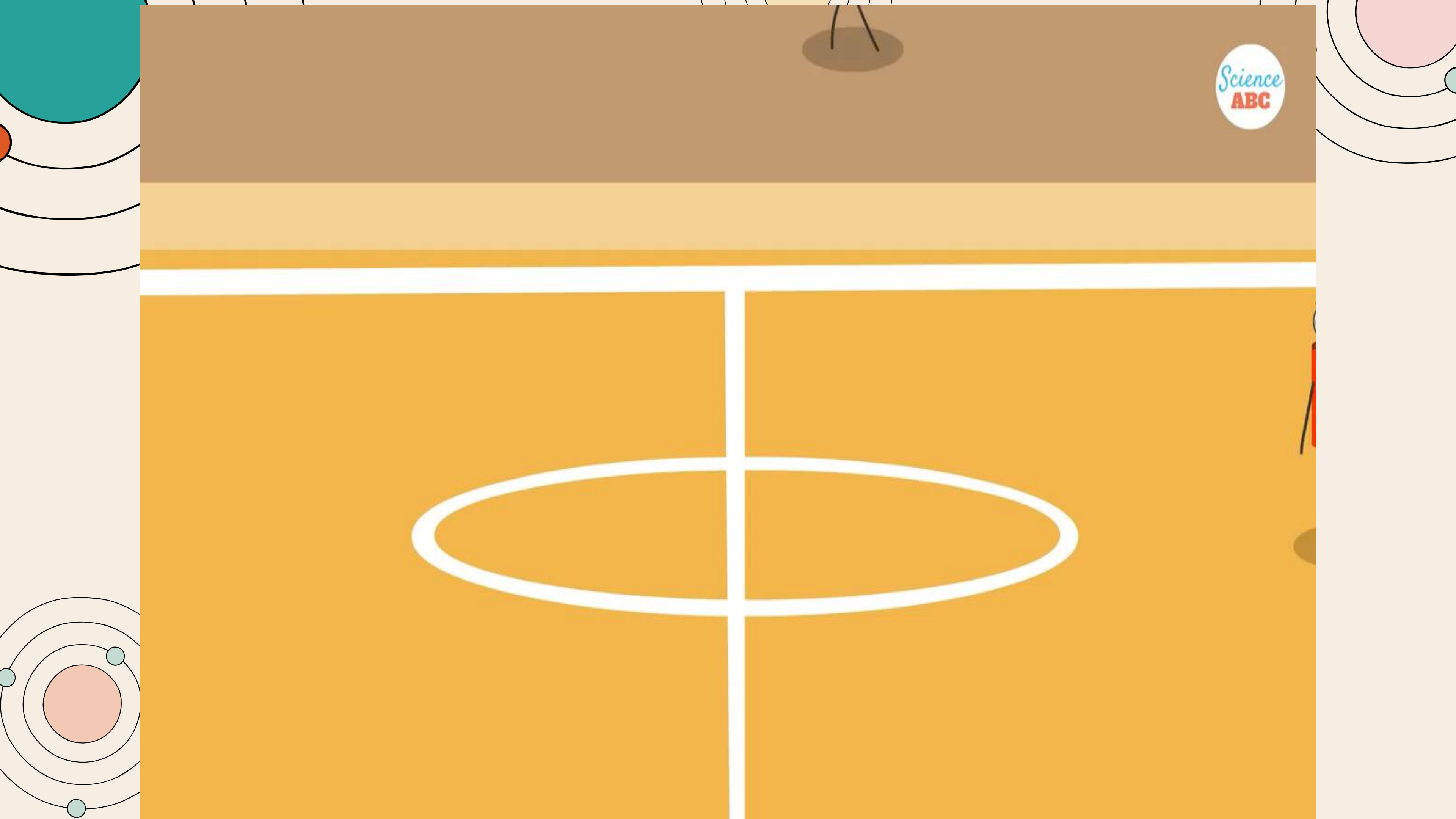
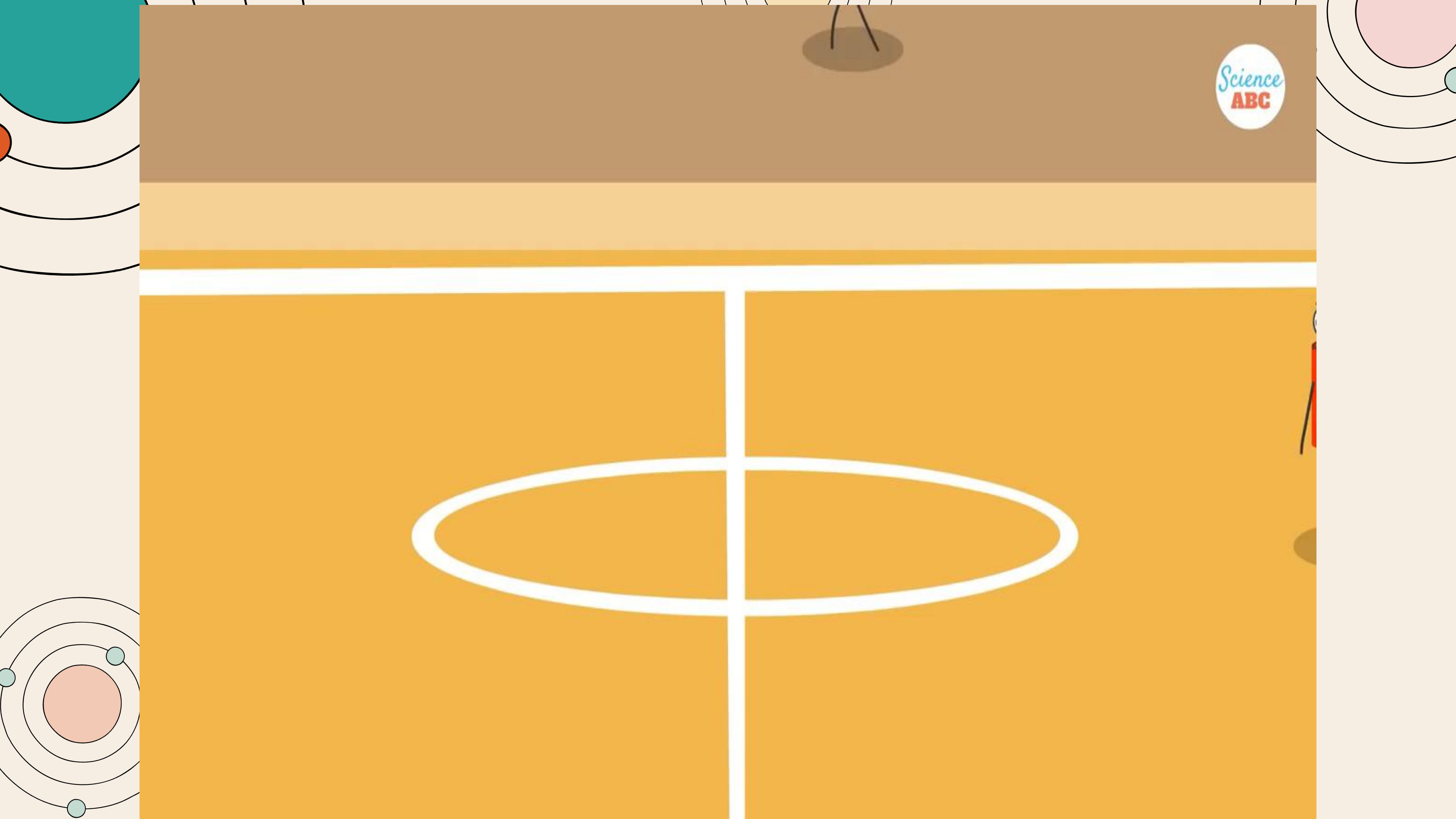


JAMES CHADWICK

- (1932) He discovered a second type of subatomic particle in the nucleus called neutrons
- 
- 
- 
- 

Nuclear Model





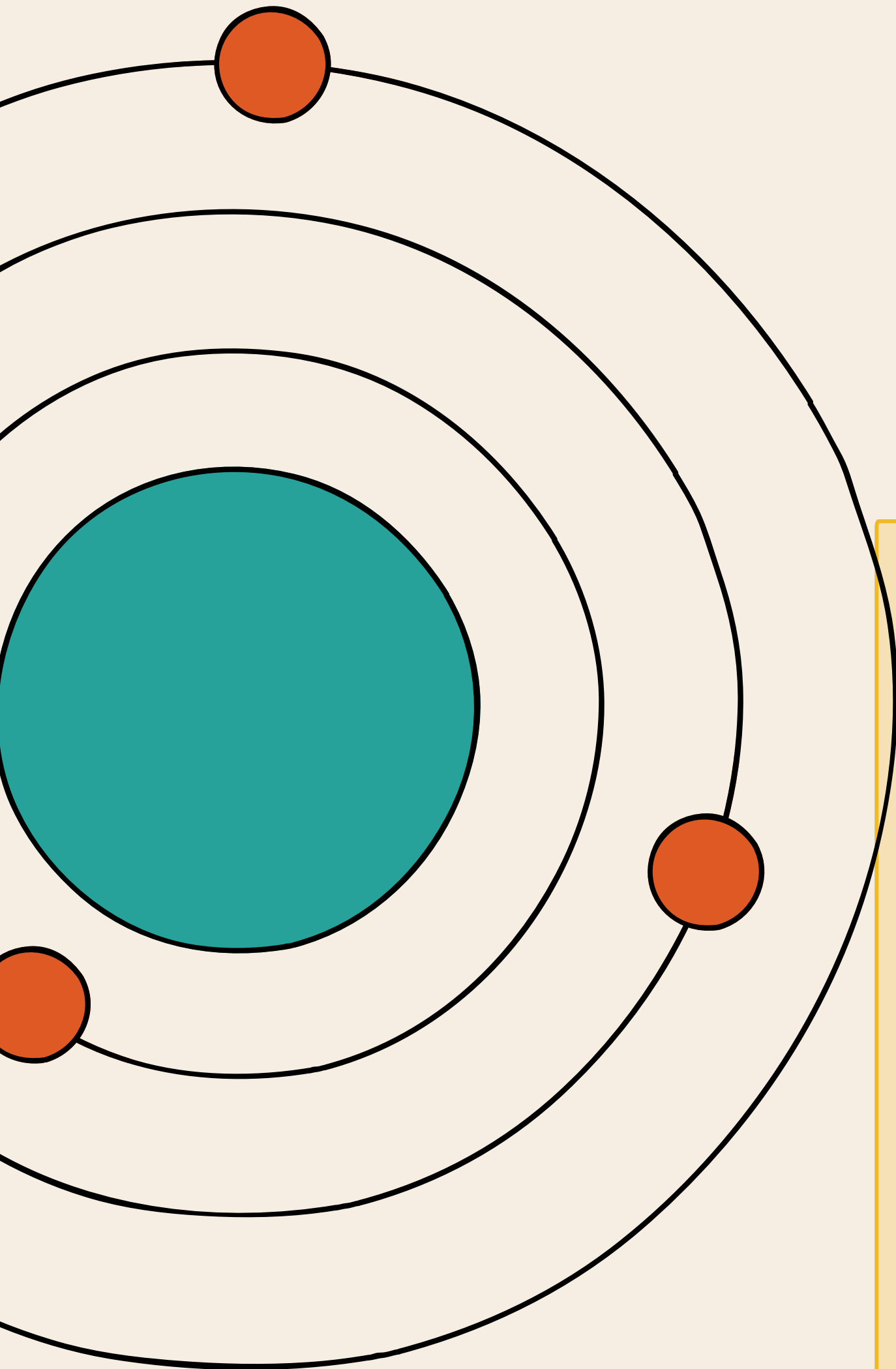
ATOMIC THEORY

1913



PLANETARY MODEL

According to this theory, electrons in an atom move along discrete, circular electron shells with quantized energies around the nucleus and these electrons can jump from one orbit to another by absorbing or emitting energy.

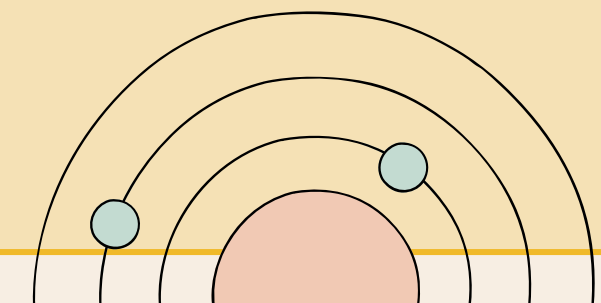


NIELS BOHR

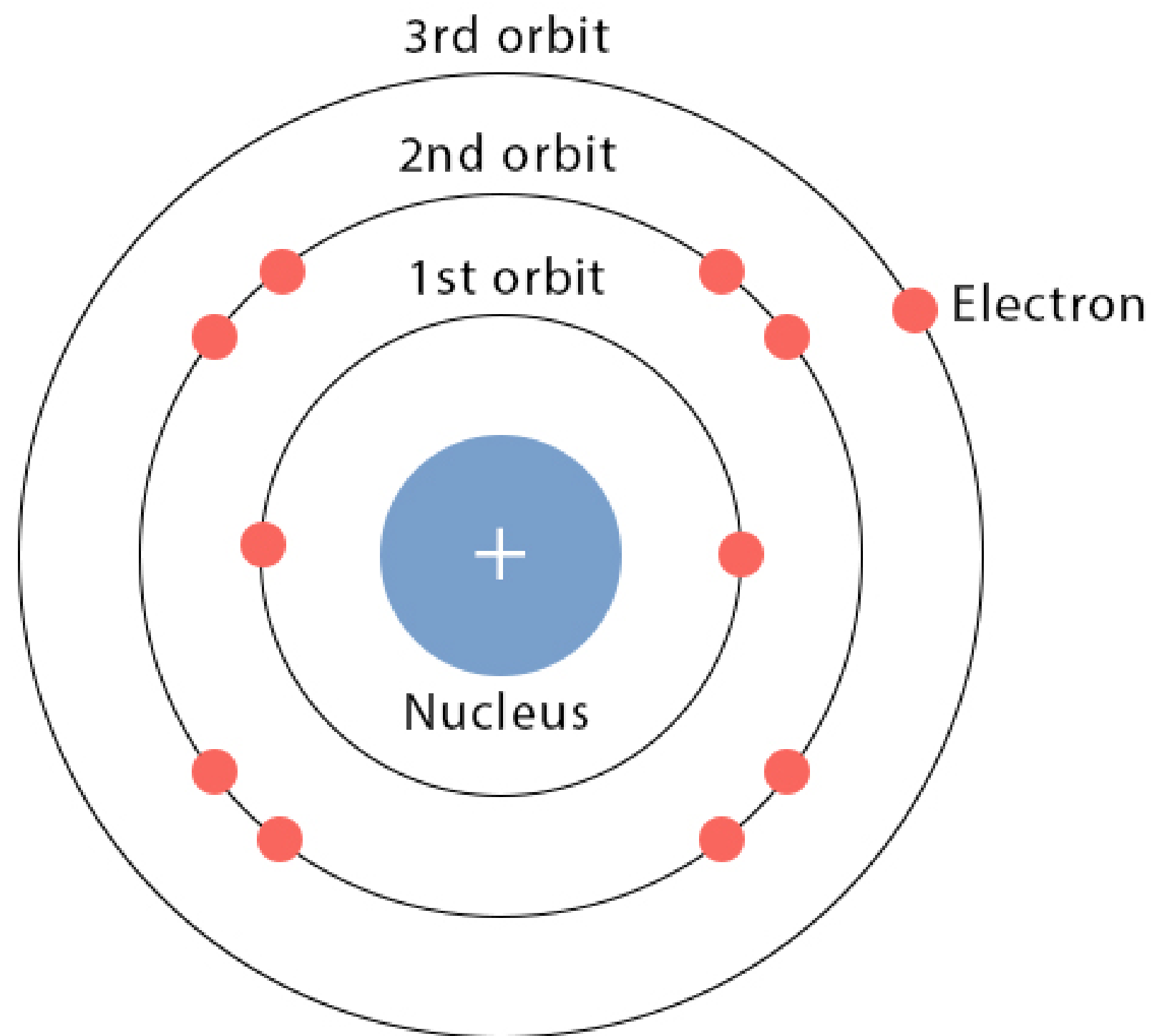
1885 - 1962

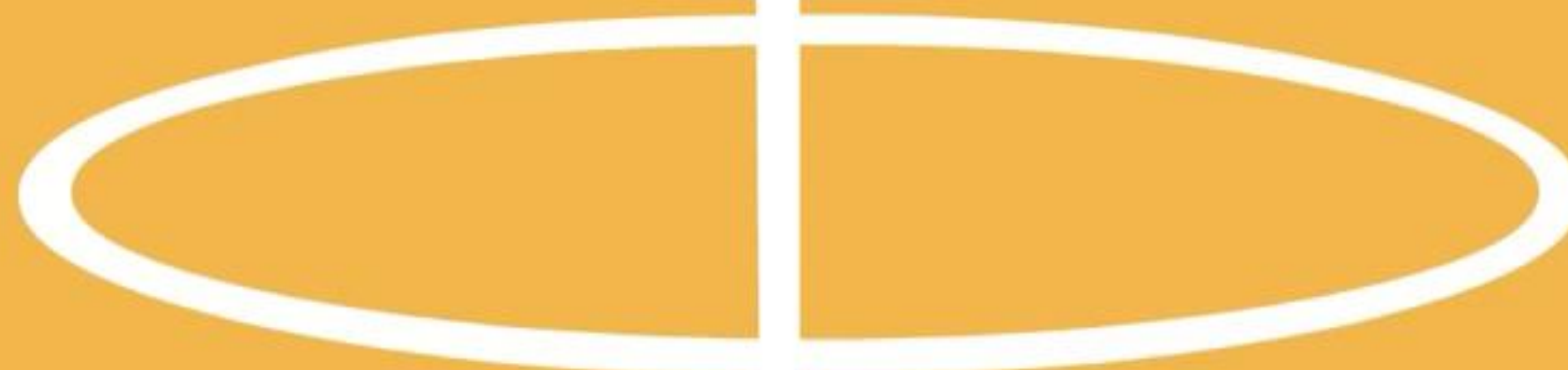


- (1913) a Danish physicist who studied the emission line spectrum of hydrogen and concluded that electrons are analogous to planets in the solar system that move along defined orbits and these orbits have varying energies depending on their distance from the nucleus and these energies are distinct or quantized



Bohr Model

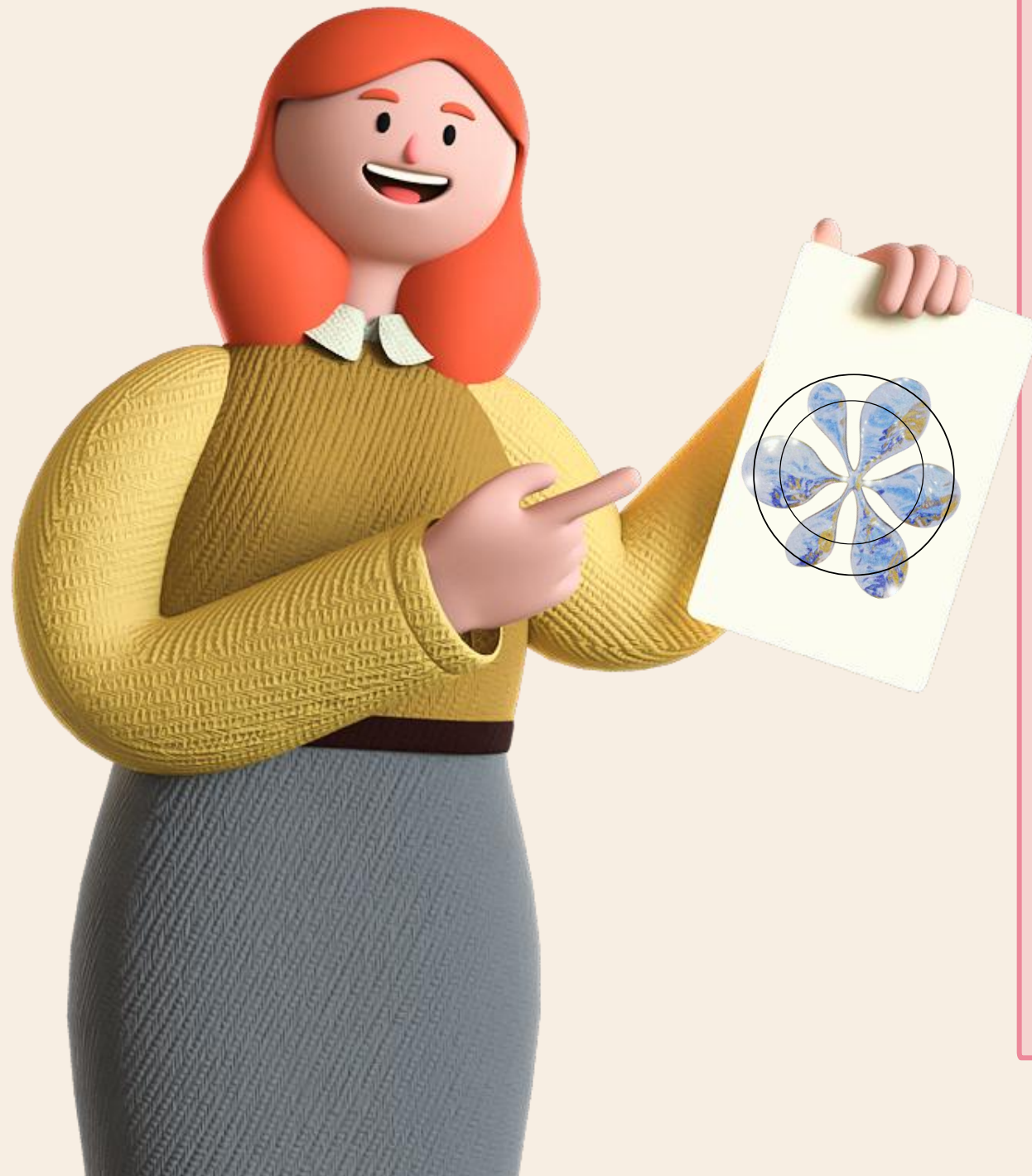




QUANTUM MECHANICAL MODEL

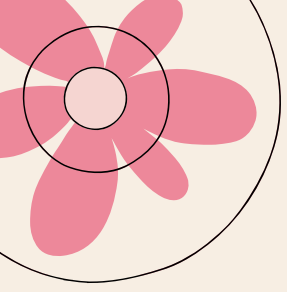
ATOMIC THEORY

1920s



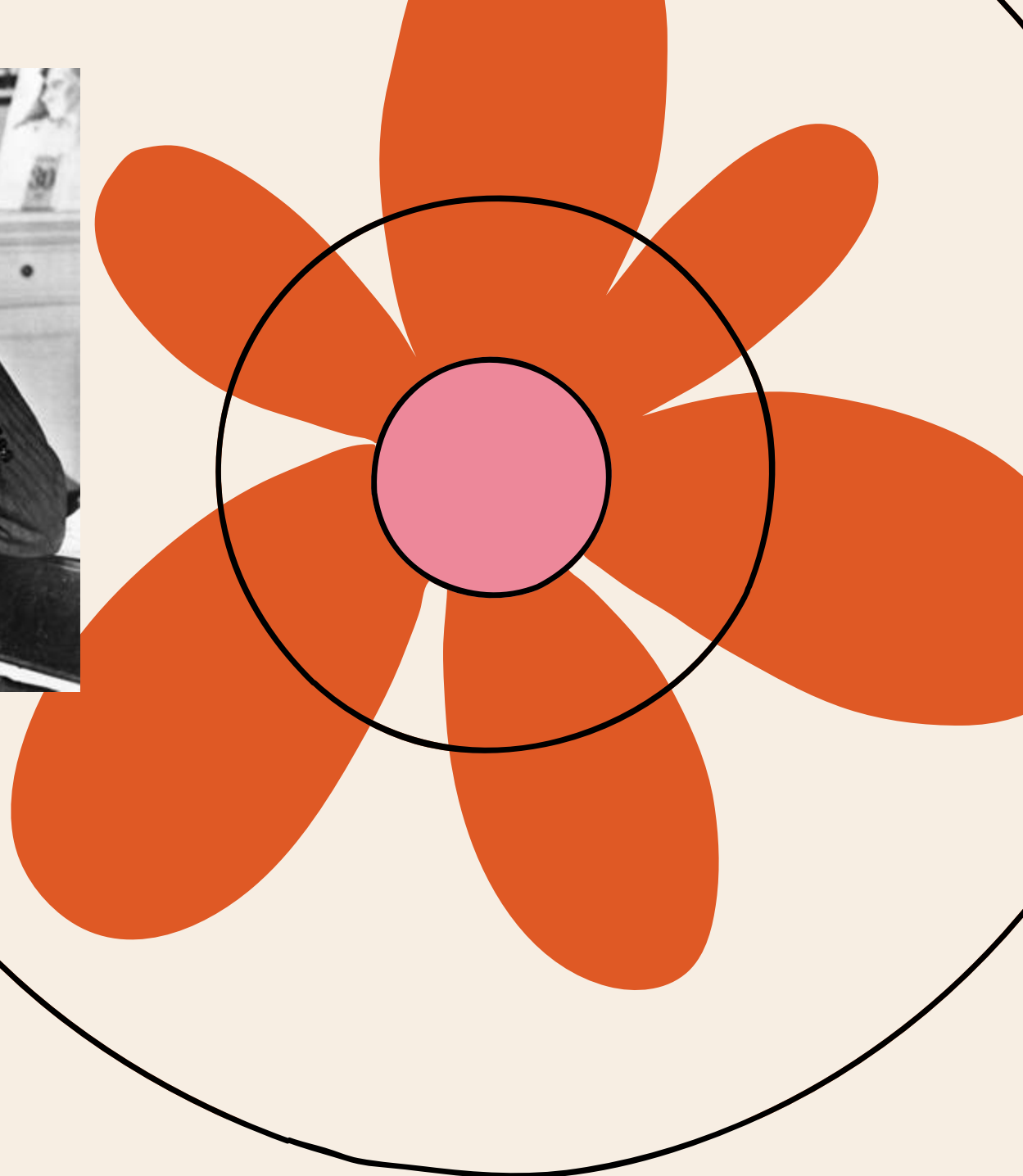
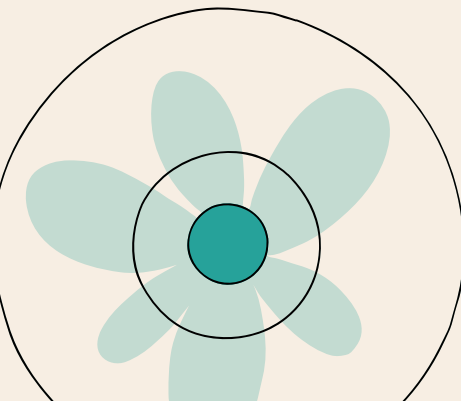
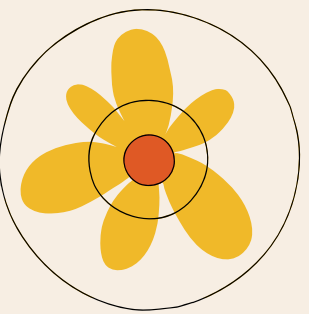
Current and most comprehensive description of atomic structure. Incorporated the wave nature of electrons in analyzing atomic properties. Electrons move in electron clouds rather than discrete circular orbits.





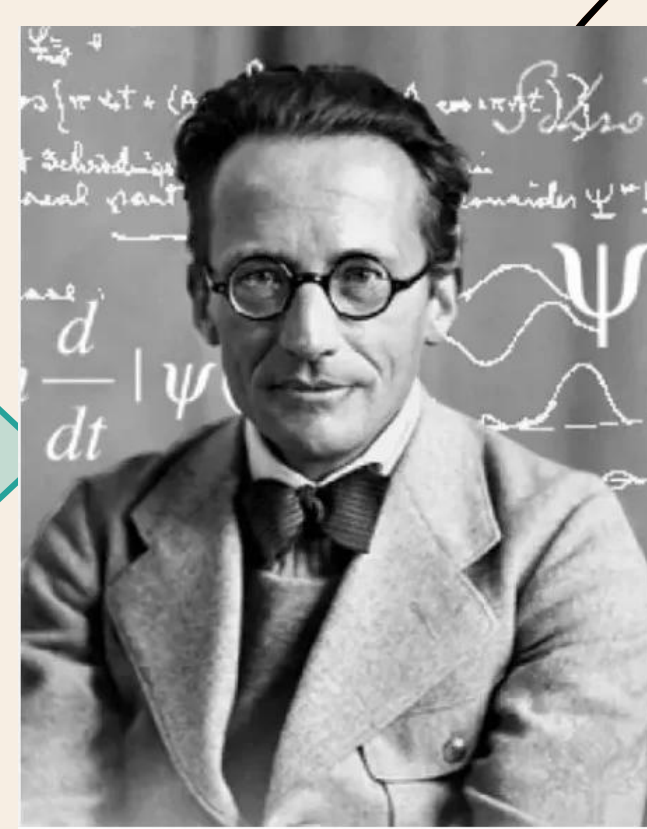
LOUIS DE BROGLIE



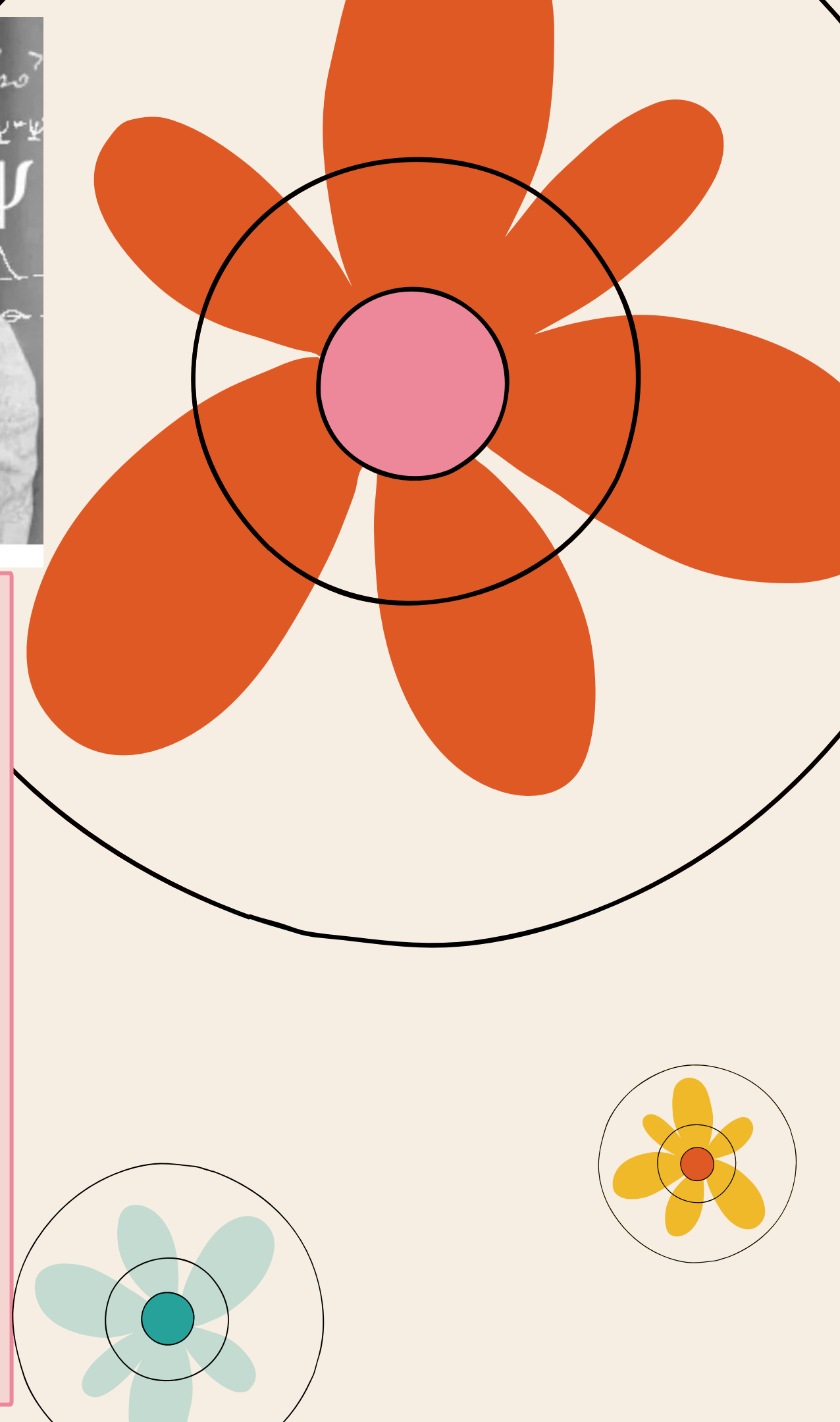
- (1924) a French physicist who was one of the roots of the quantum mechanical model through his hypothesis which stated that particles such as electrons possessed wavelike properties
- 
- 
- 

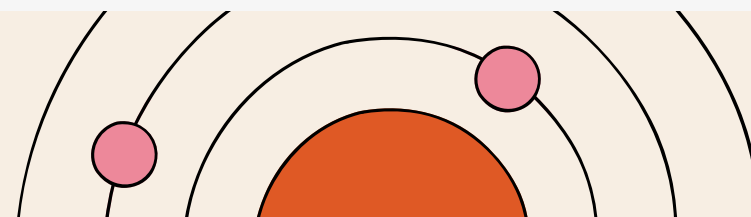
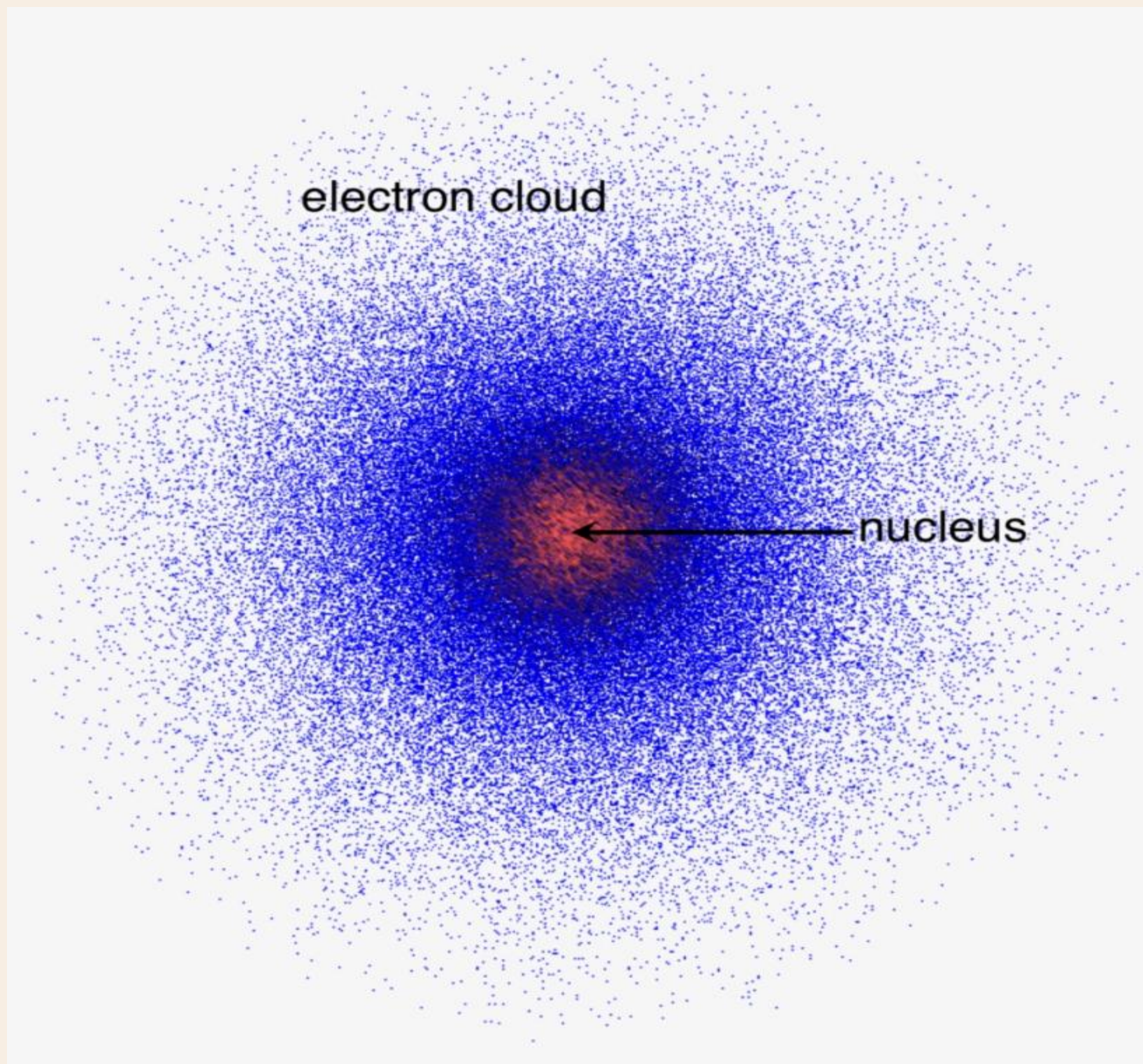
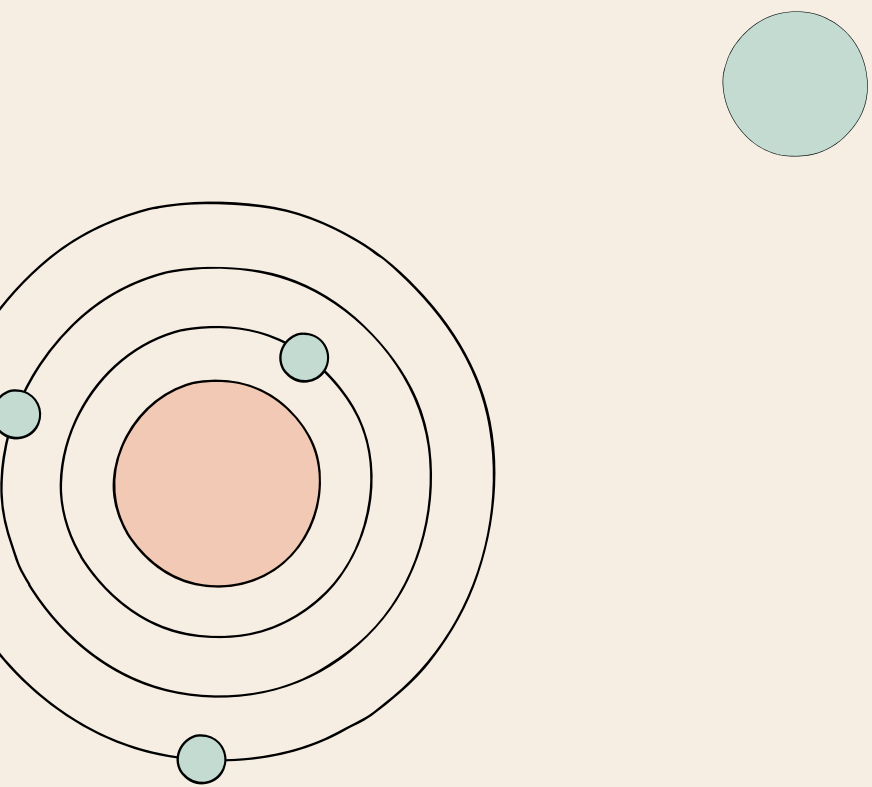
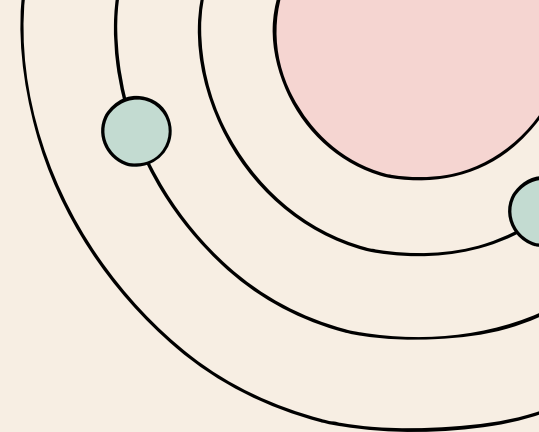
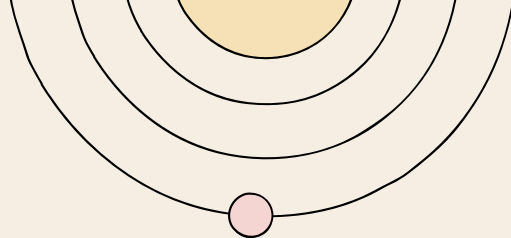
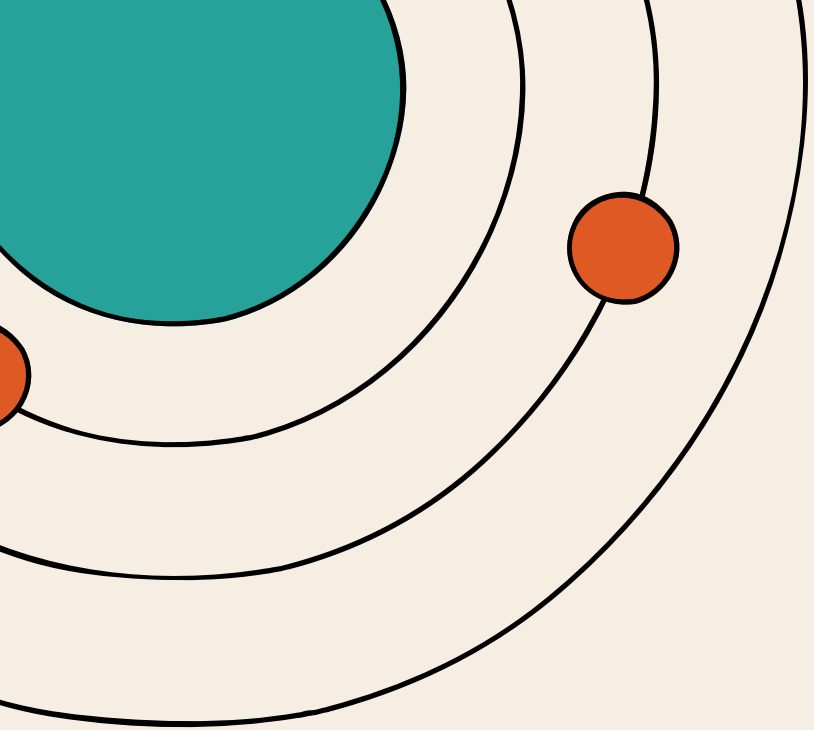
ERWIN SCHRÖDINGER

1887 - 1961



- (1926) an Austrian physicist who began studying the atoms by considering electrons as waves. He formulated a mathematical equation that allowed the calculation of the probabilities of finding an electron in a given region within the atom

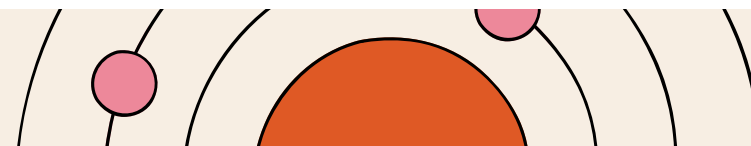
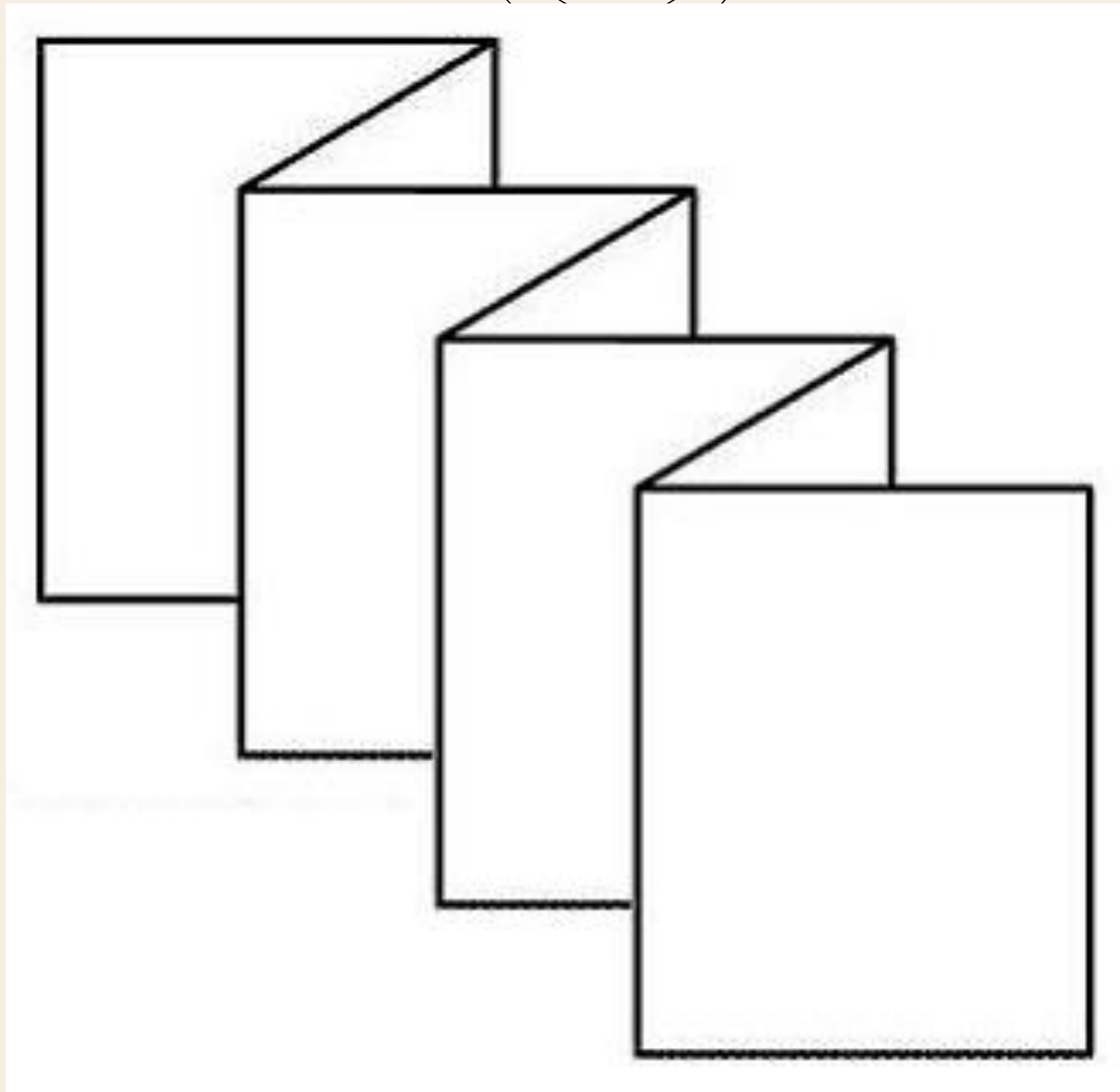
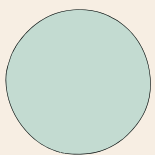
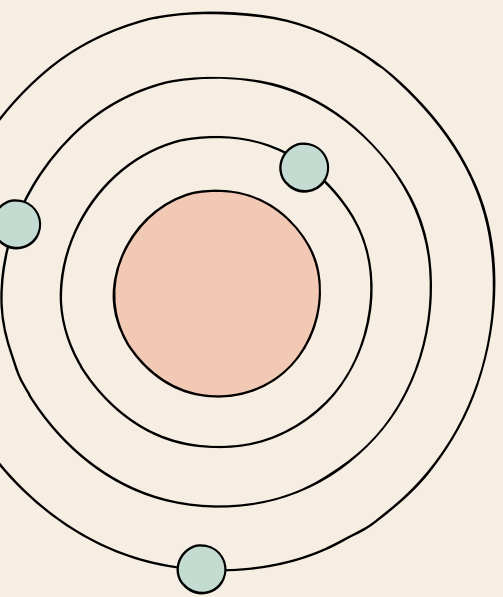
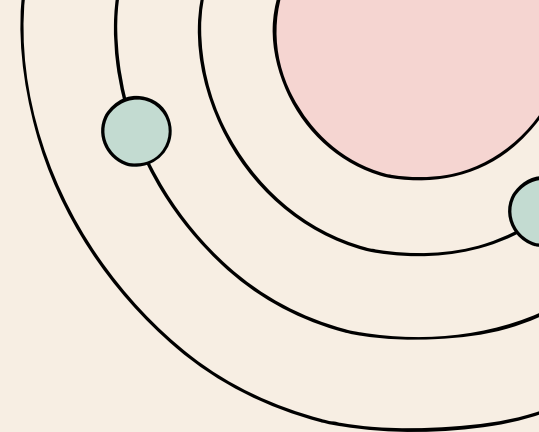
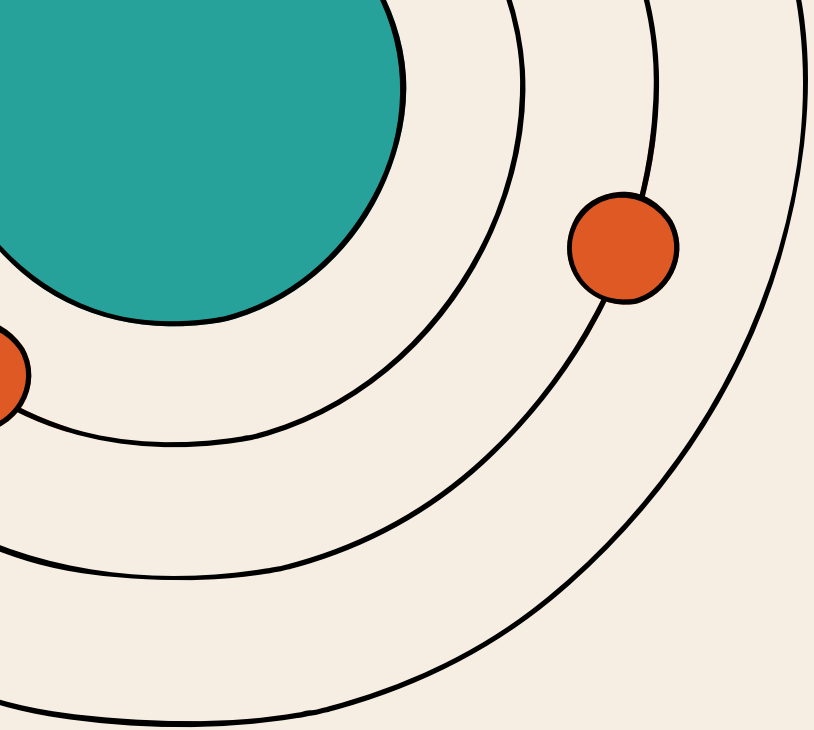




ATOMIC MODEL FOLDABLE TIMELINE

- **Construct a foldable timeline of the atomic model.**
- **Each panel of your foldable should include all of the following information:**
 - **Name of the atomic model (and other name)**
 - **Name of proponent scientist and Year (in order from earliest to most recent)**
 - **Brief description of model**
 - **Illustration/picture**





Democritus



"Democritus Model"

*Solid round ball

-Thought nature's basic particle was an atom.

-This view was not supported by any experiments.

-Believed atoms were a round, solid ball.

400 B.C.

John Dalton

"Dalton's Atomic Theory"



*Solid sphere model

-Atoms cannot be divided, created or destroyed.

-Atoms of a given element are identical.

-Atoms of different elements have different chemical and physical properties.

J.J. Thomson



"Plum Pudding Model"

*Negative charge distributed among positive charge.

-A current was passed through a cathode and a line of something glowed.

-A magnet was held to the glowing part of the cathode (called the cathode ray).

-The ray was deflected by the negative charge of the magnet, meaning the ray was negative.

-Thomson called this ray electrons.

1897

Ernest Rutherford



"Planetary Model"

*Nucleus of positive charge and a cloud of negative charge.

-Alpha particles were shot through gold foil.

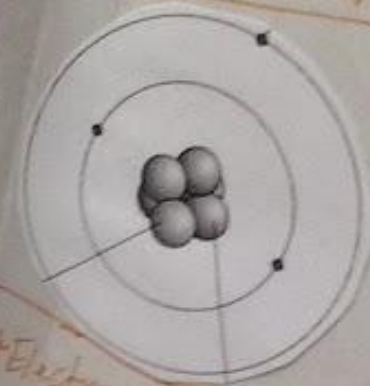
-Some particles were deflected straight back.

-There had to be a small, concentrated, positive charge in the middle of the atom.

-Rutherford called this a nucleus.

1911

Niels Bohr



"Bohr"

*Electrons rotate around nucleus like planets around the solar system.

-After Bohr aided Rutherford in his experiment with gold foil, Bohr created his own model.

-Bohr Rutherford's student.

-Electrons surround the nucleus like planets around the Sun.

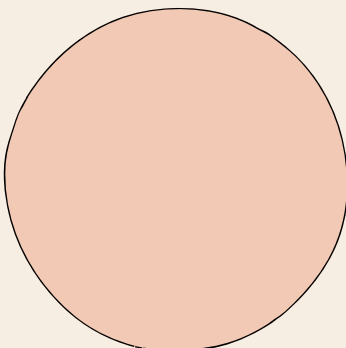
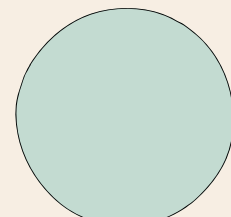
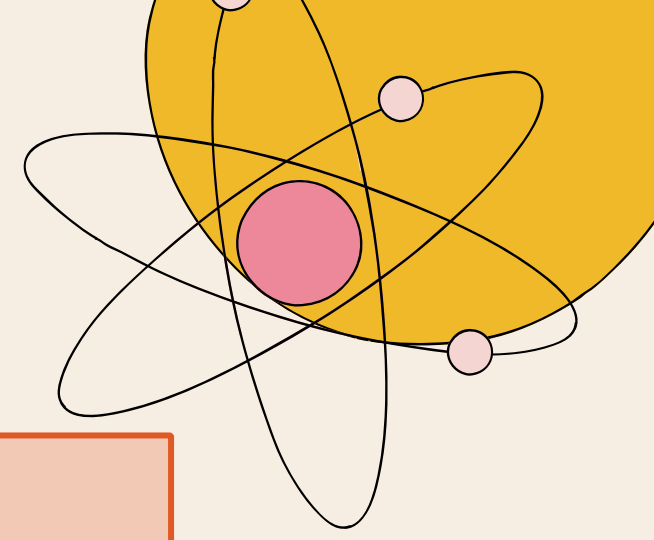
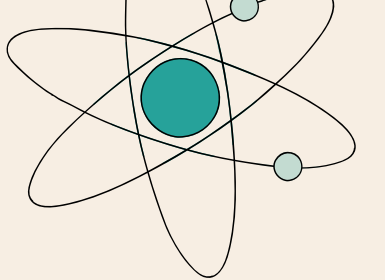
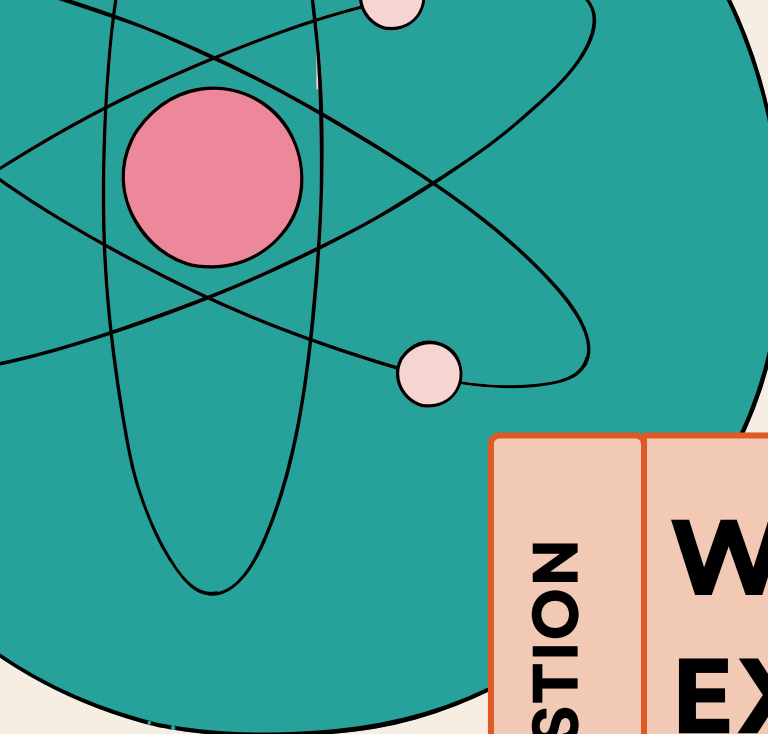
1913

A History of the Atom: Theories and Models



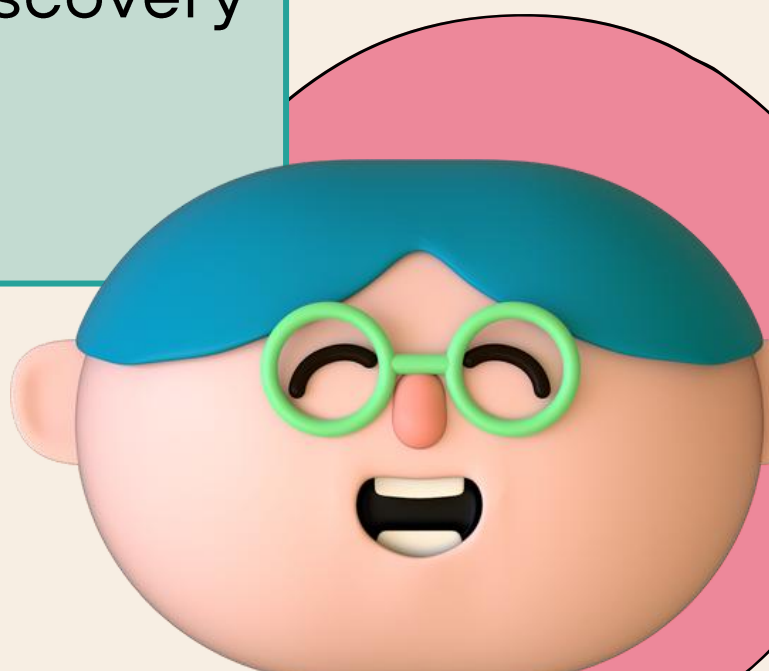
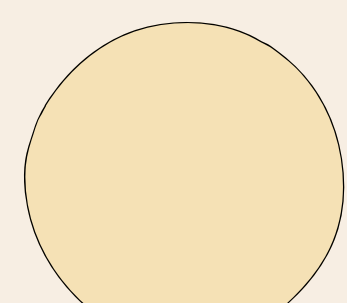
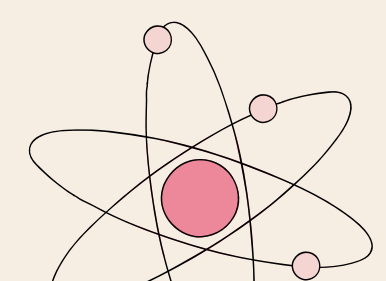
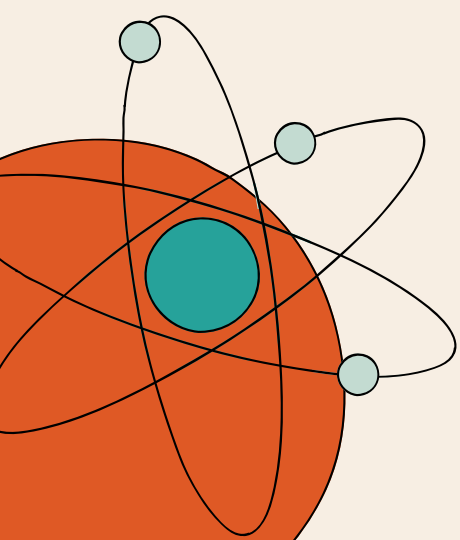
How have our ideas about atoms changed over the years? This graphic looks at atomic models and how they developed.

Solid sphere model	Plum pudding model	Nuclear model	Planetary model	Quantum model
John Dalton	J.J. Thomson	Ernest Rutherford	Niels Bohr	Erwin Schrödinger
 1803	 1904	 1911	 1913	 1926
Dalton drew upon the Ancient Greek idea of atoms (the word 'atom' comes from the Greek 'atomos' meaning indivisible). His theory stated that atoms are indivisible, those of a given element are identical, and compounds are combinations of different types of atoms.	Thomson discovered electrons (which he called 'corpuscles') in atoms in 1897, for which he won a Nobel Prize. He subsequently produced the 'plum pudding' model of the atom. It shows the atom as composed of electrons scattered throughout a spherical cloud of positive charge.	Rutherford fired positively charged alpha particles at a thin sheet of gold foil. Most passed through with little deflection, but some deflected at large angles. This was only possible if the atom was mostly empty space, with the positive charge concentrated in the centre: the nucleus.	Bohr modified Rutherford's model of the atom by stating that electrons moved around the nucleus in orbits of fixed sizes and energies. Electron energy in this model was quantised; electrons could not occupy values of energy between the fixed energy levels.	Schrödinger stated that electrons do not move in set paths around the nucleus, but in waves. It is impossible to know the exact location of the electrons; instead, we have 'clouds of probability' called orbitals, in which we are more likely to find an electron.
 Recognised that atoms of a particular element differ from other elements.	 Recognised electrons as components of atoms.	 Realised that positive charge was localised in the nucleus of an atom.	 Proposed stable electron orbits; explained the emission spectra of some elements.	 Shows electrons don't move around the nucleus in orbits, but in clouds where their position is uncertain.
 Atoms aren't indivisible – they're composed from subatomic particles.	 No nucleus, and didn't explain later experimental observations.	 Did not explain why electrons remain in orbit around the nucleus.	 Moving electrons should emit energy and collapse into the nucleus; model did not work well for heavier atoms.	 Still widely accepted as the most accurate model of the atom.



QUESTION

WHAT DID RUTHERFORD'S GOLD FOIL EXPERIMENT REVEAL ABOUT THE ATOMIC NUCLEUS?



ANSWER

Rutherford's gold foil experiment revealed that most of the atom's mass is concentrated in a small, positively charged nucleus at the center. This discovery overturned the idea of a uniformly distributed positive charge.

THANKS FOR PLAYING

