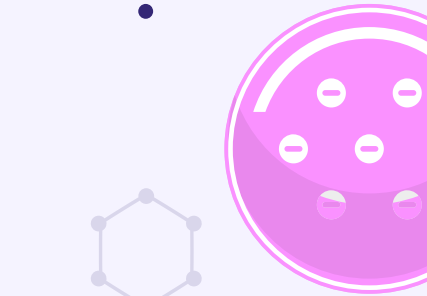
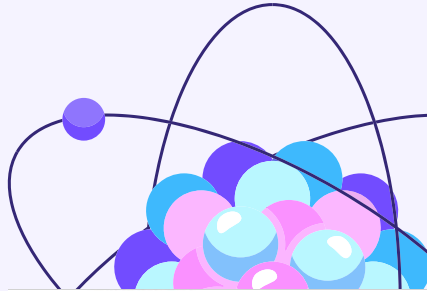
Evolution of Atom Models

By: Erick Melena, Wyatt Best, Vianney Solis





EMPACTS Project, Fall 2023
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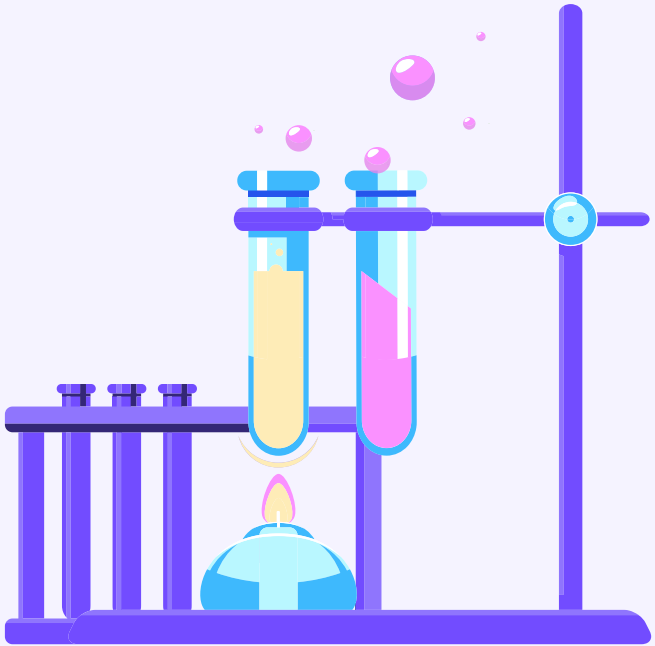

EMPACTS Project was Created by:

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Vianney Solis
Erick Melena

Project Introduction

We are students in Physics and Human Affairs and researched the evolution of Atoms for our class EMPACTS Project.

Our objective is to apply our course curriculum and produce a instructional presentation that will aid future STEM learners in understanding the history of the changes of the model of the atom.

Curriculum

This project covers introduction to atoms from the course syllabus.

Technology

Technologies used include Google Slides, Google Documents, Google Drive, and Microsoft Teams.

Methodology

Our methodology included beginning with an outline of information that we would use for our slides. We met as a group to create our 3D models and consolidate our information.

Community Application

This project serves to inform our fellow students within the community of this basic but very necessary concept.

The product of our learning experience is as follows...

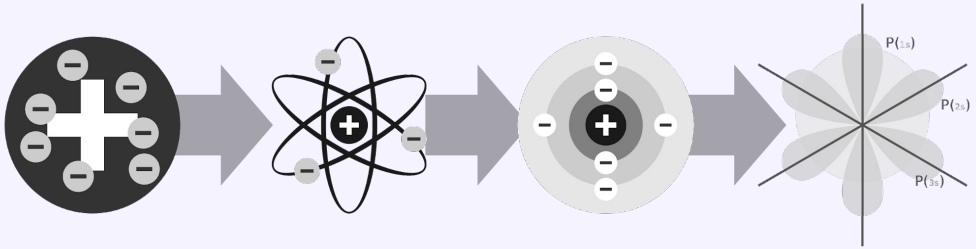
Introduction to Atomic Models:

The atomic model has gone through many changes through the years and many scientist have discovered new components to it. The atom is a piece of science that is proof of how science evolves and changes as we move forward. Though there have been many variations of the atom and there have been multiple models done to show the evolution today we will only be taking a deeper look into three of the models, and briefly discuss the rest.

The timeline and general idea of the atom is the general topic of our presentation. As you'll see, many models were proposed and changed, as new discoveries were made...

• What are Atoms?

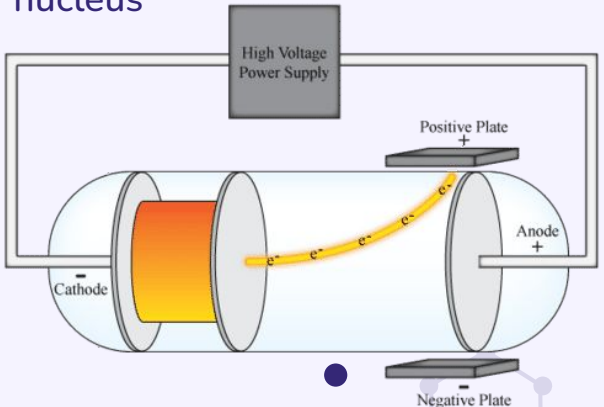
- Everything is made of matter!
- Matter is made of atoms!
- Atoms are tiny particles that are indivisible! They move depending on what state of matter they are in.



- Thomson showed electrons exist due to demonstrating their deflection inside a cathode ray tube.

Electron Discovery!

- Electrons were discovered by J.J Thomson in 1897
- He created his own model known as the Plum Pudding Model which just consisted of only electrons and no nucleus
- Model was accepted at the time until Ernest Rutherford came along and discovered the nucleus



Early Atomic Models

Atomism

Discovered by;
Democritus

Plum Pudding

Discovered by;
J.J. Thomson

Solid Sphere

Discovered by;
John Dalton

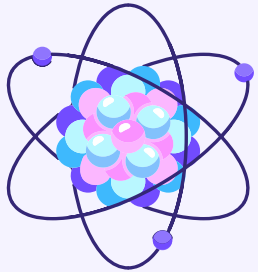
Atomic Models

Dalton

Solid sphere model that was thought to be indivisible

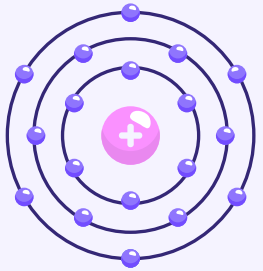
Thomson

Electrons would float around a positively charged cloud



Nuclear

Demonstrated electrons orbiting nucleus



Bohr

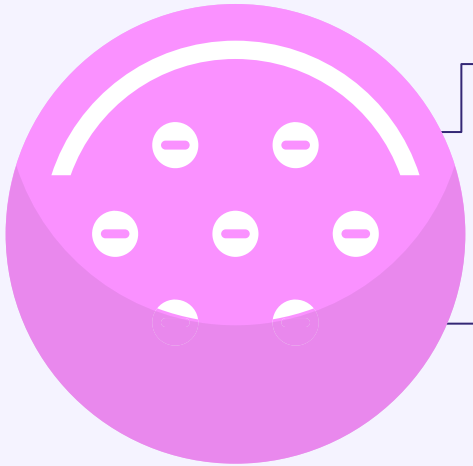
Electrons orbited the nucleus in a fixed energy path

Discovering the Atomic Model

Democritus was the first person to ask the revolutionary question, what is an atom? He smelled fresh bread and wondered how the particles traveled to his nose to deliver the scent. This is how curiosity struck...

Dalton took this idea and he then came up with the idea that this could be a solid indivisible atom formulated of the same element.

Thomson's Plum Pudding Model



Negative Electrons

Electrons floating around

Cloud of Positive Charge

Positively charged cloud that would surround the electrons

Timeline of Atomic Models

Nuclear

Discovered;
Ernest Rutherford in 1911

Bohr

Discovered;
Niels Bohr in 1913

Quantum

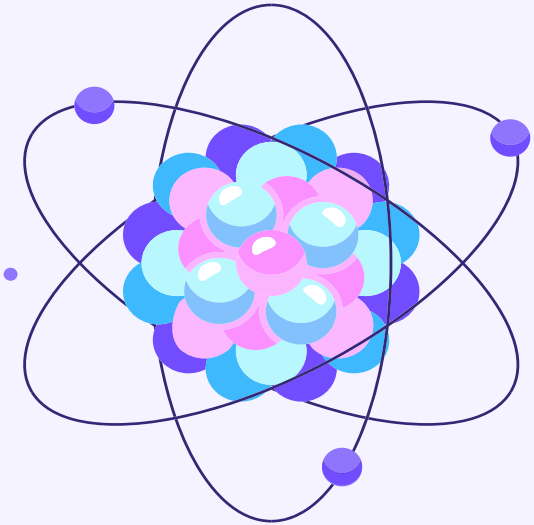
Discovered;
Erwin Schrödinger in 1926

01

Nuclear Model

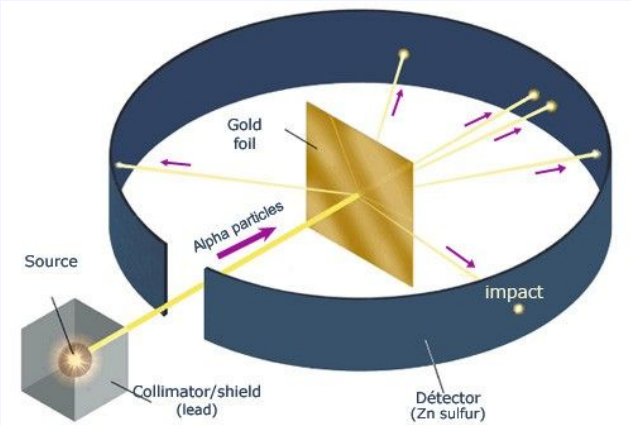
Nuclear Model

- Discovered by Ernest Rutherford in 1911
- Discovered the nucleus being the most dense spot in the center of the atom
- Originally thought that electrons orbited the nucleus like planets orbiting the sun



Nuclear Model

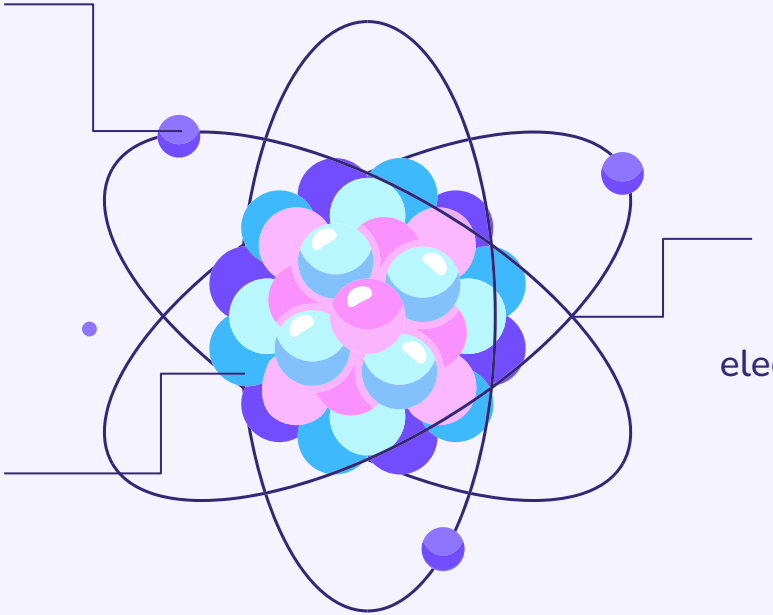
- Rutherford’s experiment to conclude there was a small, very dense and positive center was to fire a beam of alpha particles a thin sheet of gold foil
  - Many times, alpha particles would go right through
- But sometimes, these alpha particles would be knocked back and undergo a dramatic collision
- Alpha particles are helium nuclei - 2 protons & 2 neutrons



Parts of a Nuclear Atom:

Electrons

Electrons orbit the nucleus on fixed paths.



Fixed Paths

The paths that electrons travel around the nucleus

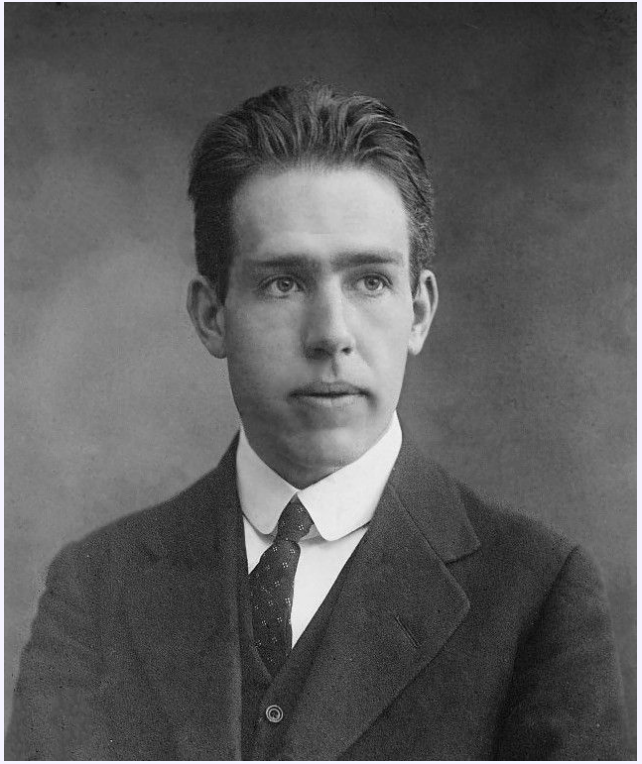
Nucleus

The nucleus contains protons and neutrons in the center

Then Came Along ...

Niels Bohr

- Danish physicist born in 1885
- Received the Nobel Prize in Physics in 1922
- Continued to study the works of Ernest Rutherford



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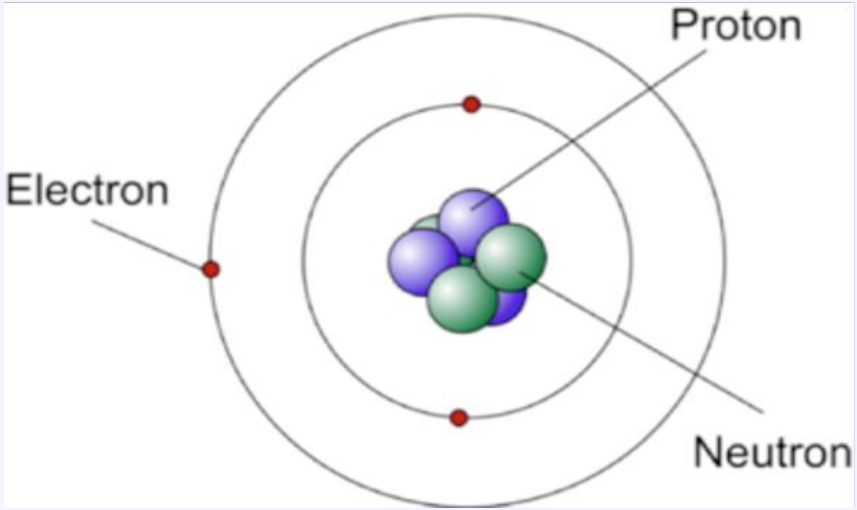
Bohr's Model

Bohr's Model

- Identified by Niels Bohr in 1913
- Proposed that electrons had fixed and discrete energy levels
- In other words, orbit the nucleus at certain distances and do not spiral inwards



Bohr's Atomic Model

Fixed Electron Path

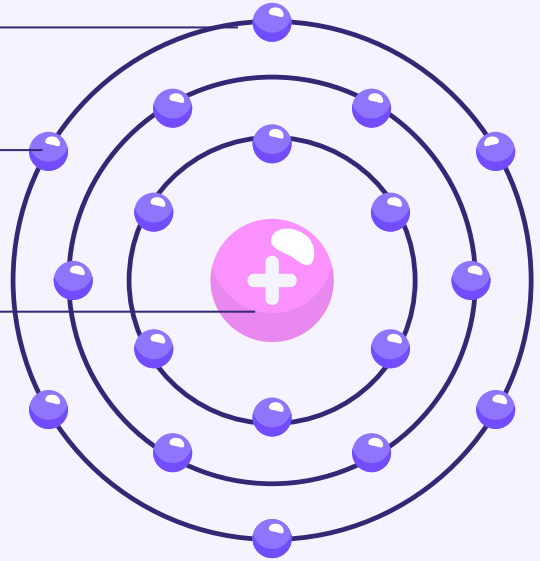
Fixed path in which the electron orbits the nucleus, dependent on the energy level

Electrons

Negatively charged particles

Nucleus

Containing protons and neutrons



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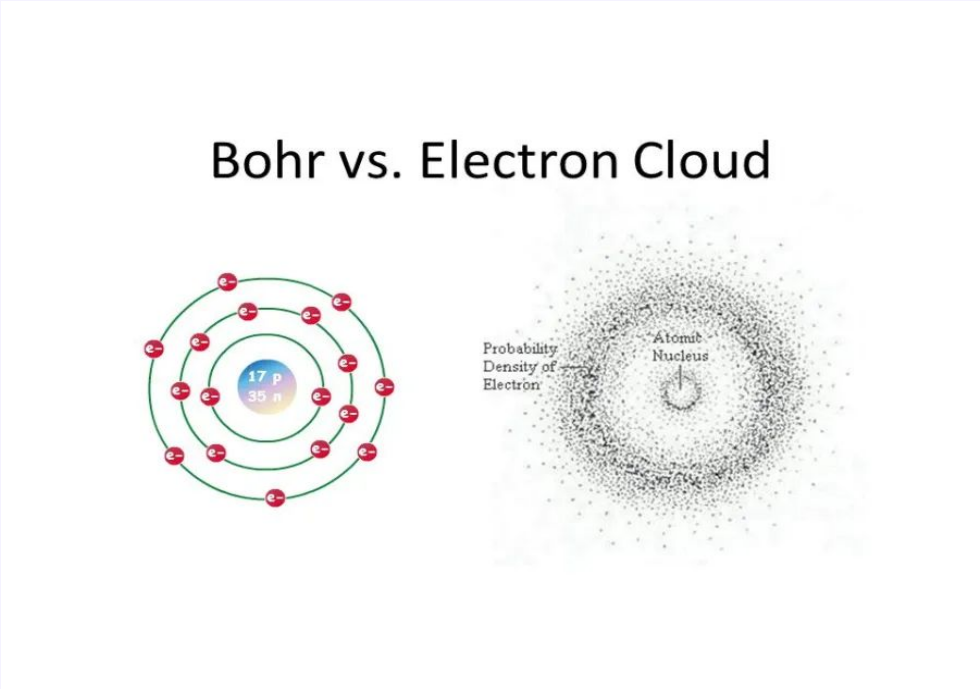
Quantum model

Bohr versus Quantum Model



In the quantum model, the more dense the cloud, the higher probability of electrons being present

Quantum Mechanics Comes Into Play ...

- Quantum physics became more studied and known in the 1920's
- Changed everyone's views on what we thought we knew
- The quantum model is the model more recently accepted

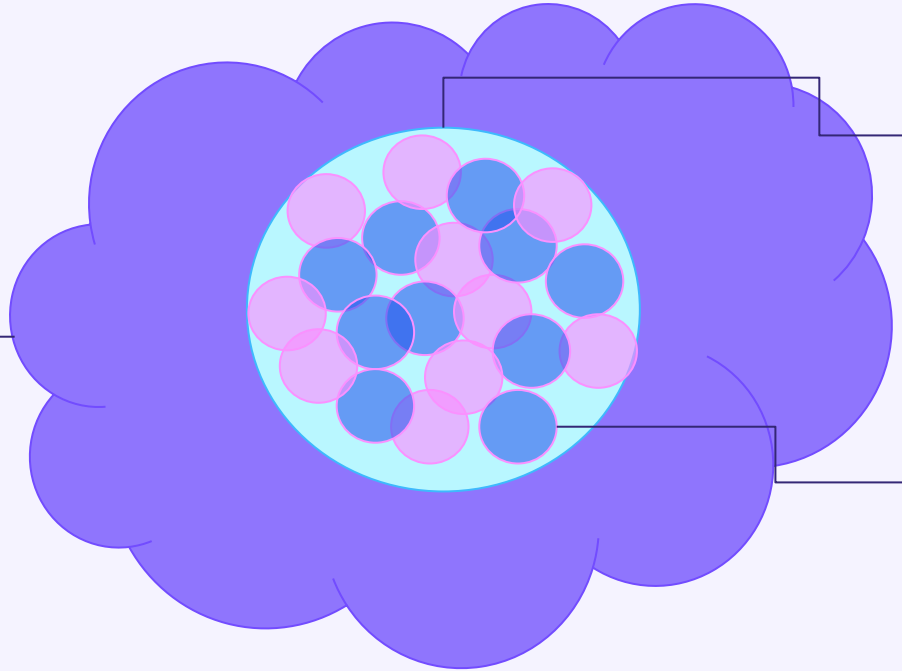
Quantum Model

- Proposed by Erwin Schrödinger in 1926
- Stated that electrons float around the nucleus like a cloud, instead of rings
- Electrons move in waves around the nucleus
- Impossible to know the exact location of the electrons; instead cloud of probability or orbitals are used to possibly identify them

Quantum Model

Electrons

Form an electron cloud surrounding the nucleus



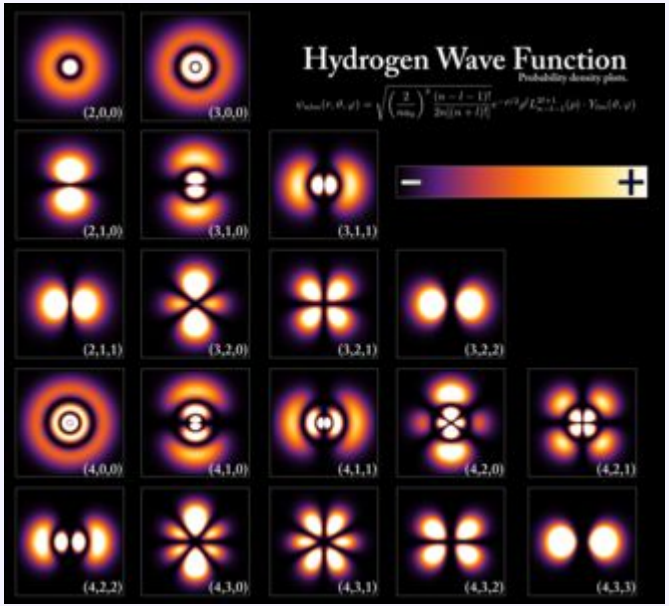
Nucleus

Contains protons and neutrons at core

Protons & Neutrons

Stabilize the core and sit in center bouncing off each other

Quantum Model Still Contains Energy Levels …



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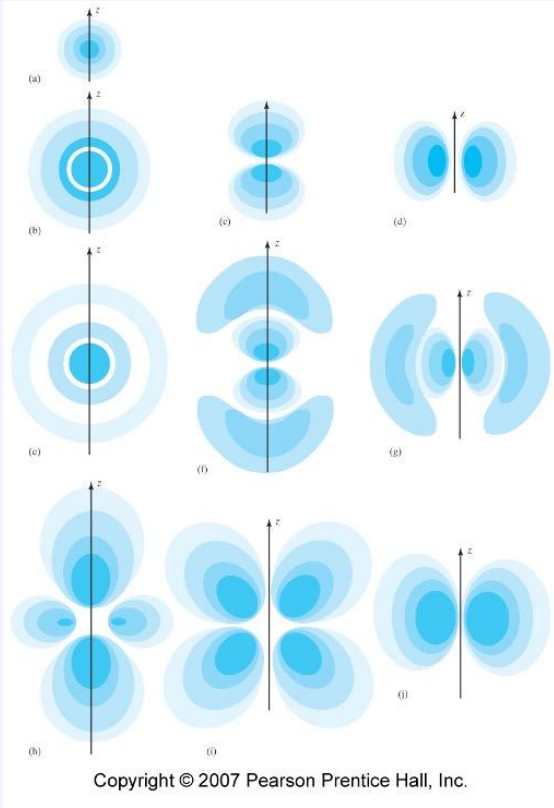
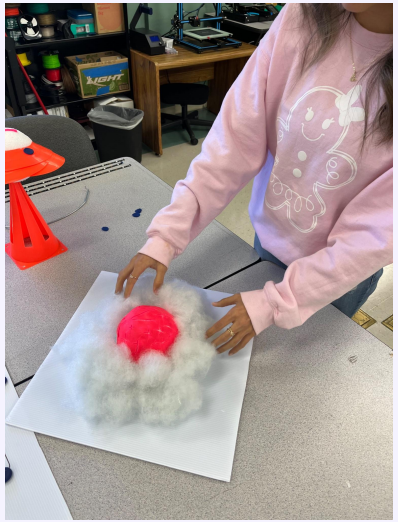
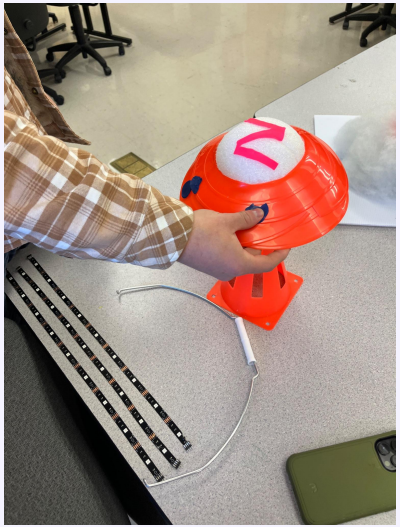


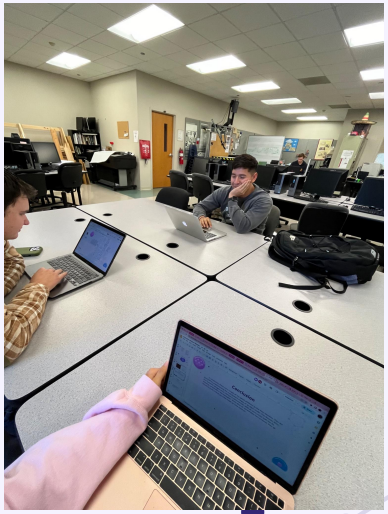
https://en.wikipedia.org/wiki/Atomic_orbital

Conclusion

In conclusion, these are a couple of the latest additions to the atom timeline. They are essential to understanding the evolutionary stages of an atom model. The Nuclear, Bohr, and Quantum designs were created to demonstrate what an atom could look like, by showing complexity in the examples. While they all served their own purpose, they all helped to build a more accurate model as time went on.







Products of our learning experience?

- Atomic theory of matter
- Apply course content to serve the community
- Work in teams - collaborate with team
- Confidently use technology to achieve our project goals
- Communication skills
- Critical thinking and problem solving
    - Meet as a team outside of class
- Educational Presentation - instructional
- Webpage

Acknowledgements

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Citations

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