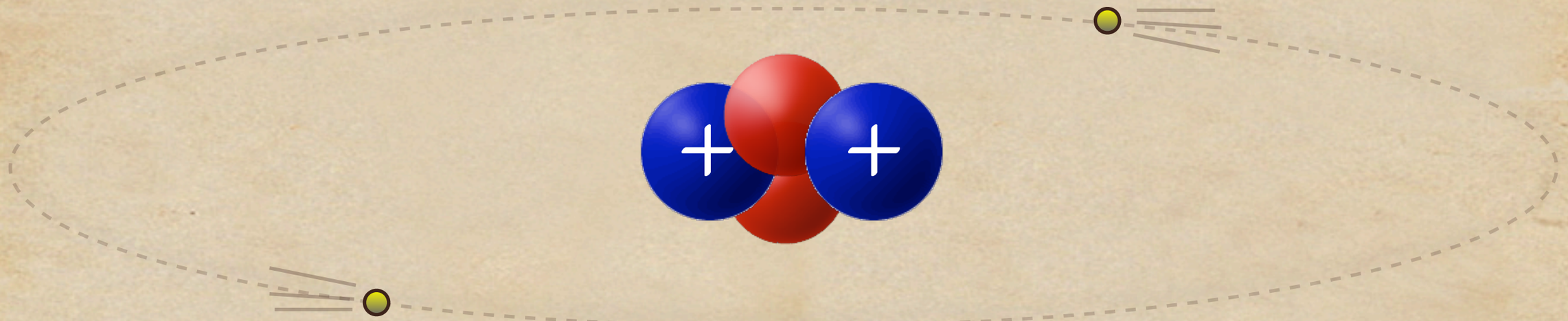
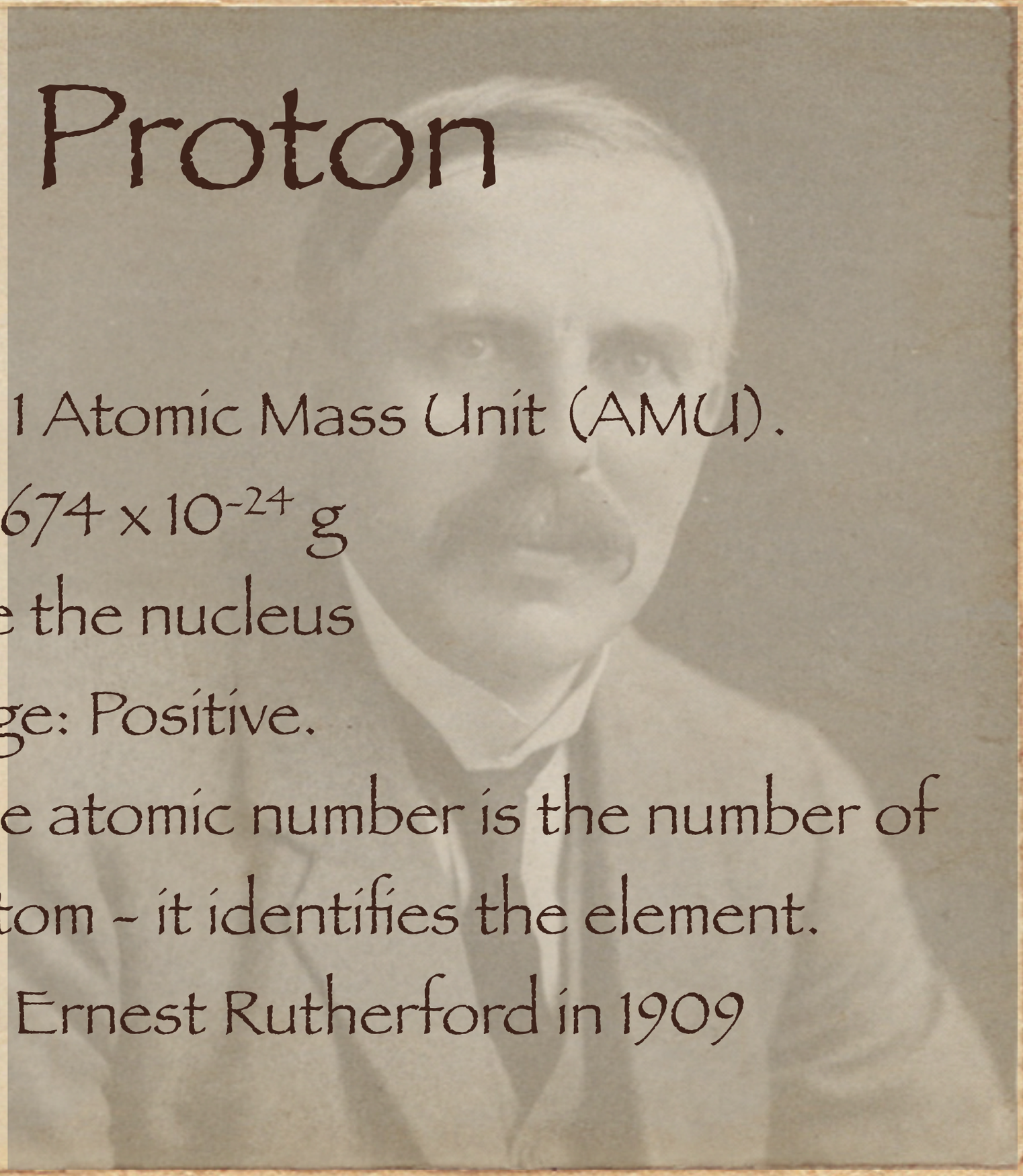
Atomic Structure & Periodic Trends



A Helium atom

The Physical Science Series

The Proton



1) Symbol = p^+
2) Relative Mass = 1 Atomic Mass Unit (AMU).

   Actual mass = 1.674×10^{-24} g
3) Location: Inside the nucleus
4) Electrical charge: Positive.
5) Importance: The atomic number is the number of protons in an atom - it identifies the element.
6) Discovered by: Ernest Rutherford in 1909

The Neutron

1) Symbol = n^0

2) Relative Mass = 1 Atomic Mass Unit (AMU).

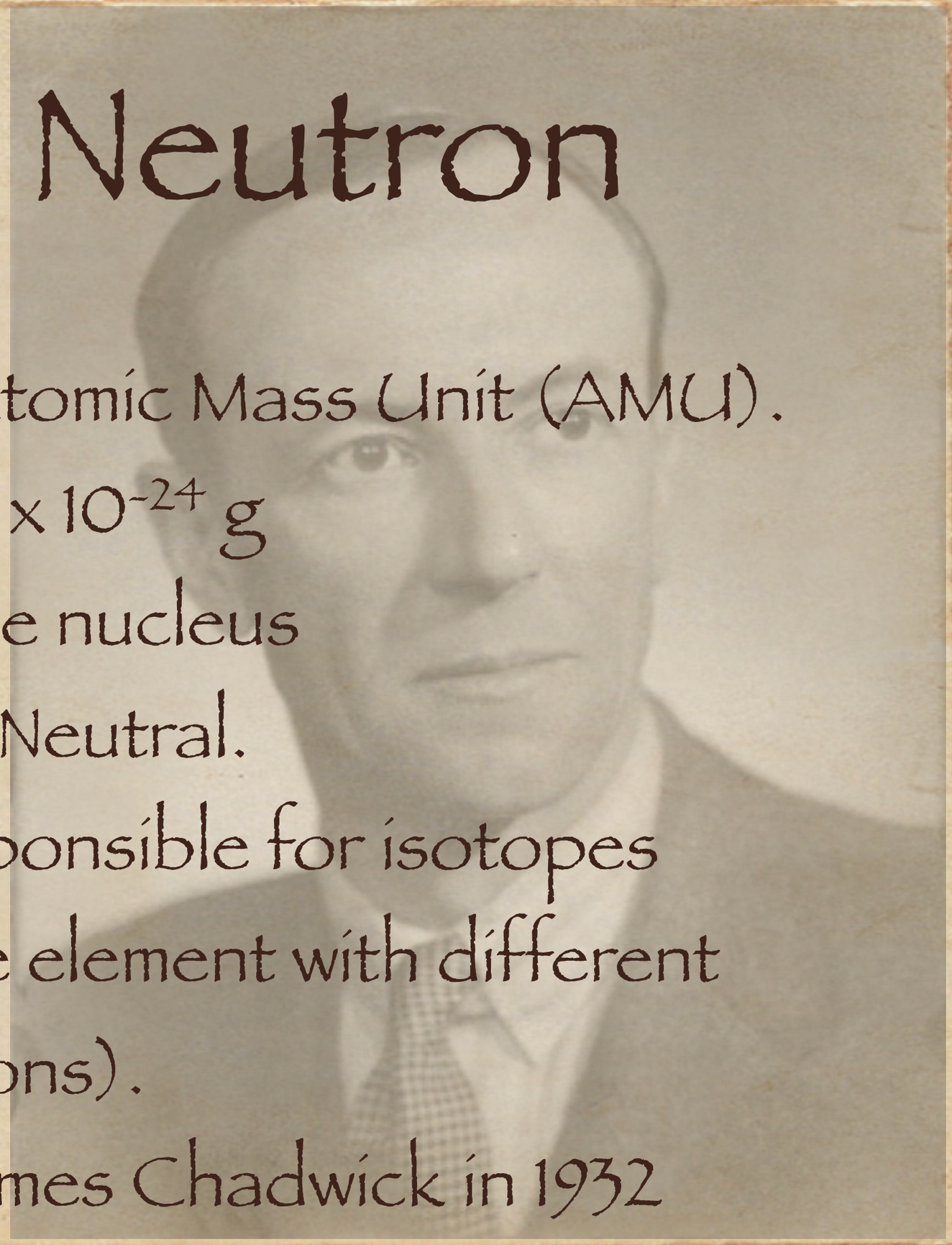
Actual mass = 1.675×10^{-24} g

3) Location: Inside the nucleus

4) Electrical charge: Neutral.

5) Importance: Is responsible for isotopes (atoms of the same element with different numbers of neutrons).

6) Discovered by: James Chadwick in 1932



The Electron

1) Symbol = e^-

2) Relative Mass = 1 /1836 Atomic Mass Unit.

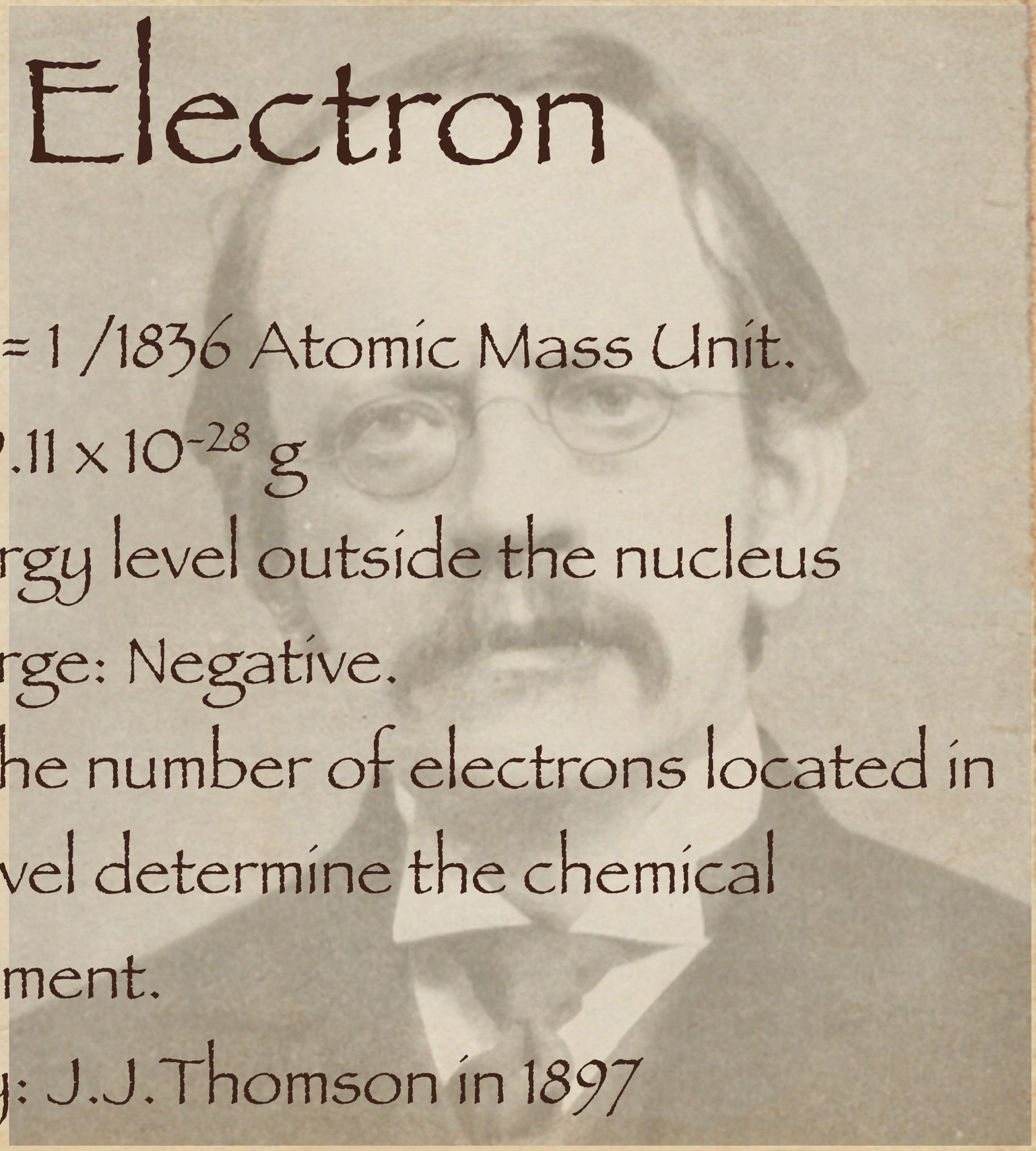
Actual mass = 9.11×10^{-28} g

3) Location: Energy level outside the nucleus

4) Electrical charge: Negative.

5) Importance: The number of electrons located in the last energy level determine the chemical activity of the element.

6) Discovered by: J.J.Thomson in 1897



Lithium

Atomic Number → 3

3 protons

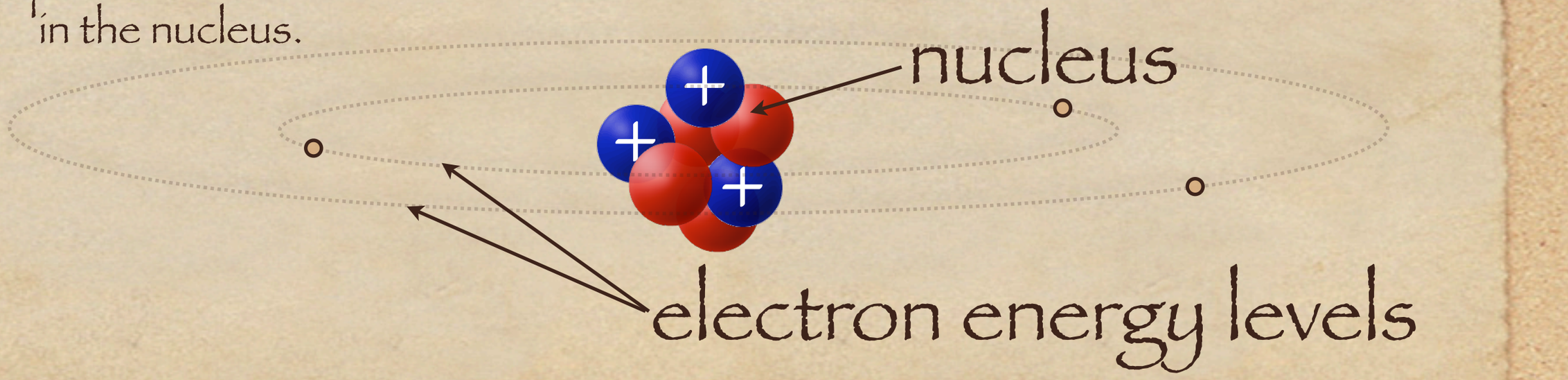
3 electrons

Li

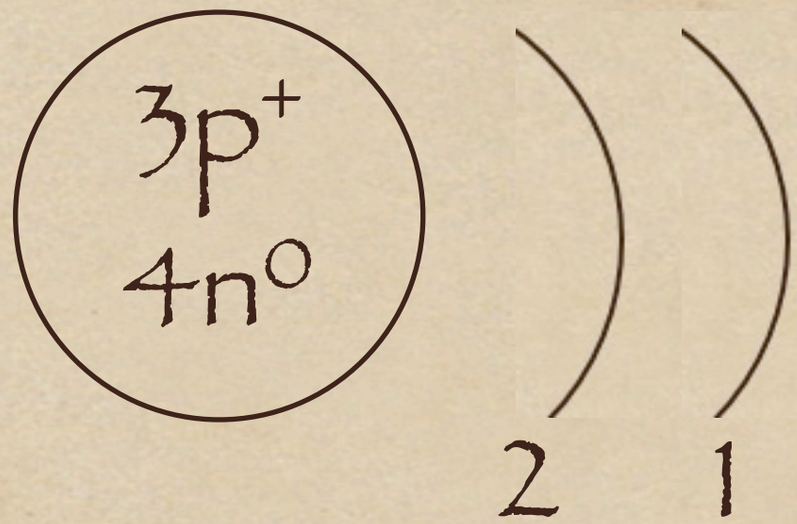
Atomic Weight (Mass) → 6.941

4 neutrons

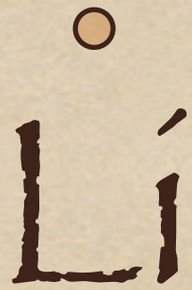
Rounded, it equals the protons + neutrons in the nucleus.



Models of Atoms

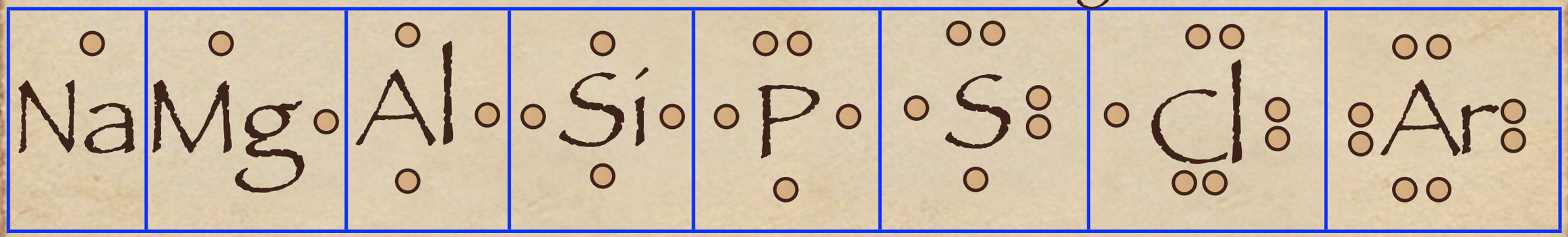


Bohr model



electron dot model

Electron dot models show only valence e⁻.

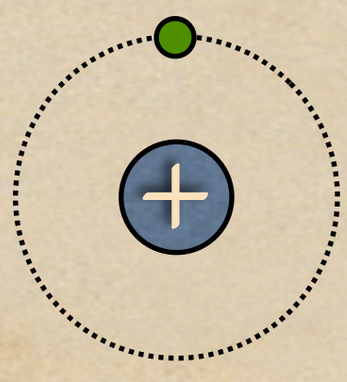


Electron dot models for Period 3 elements.

Isotopes

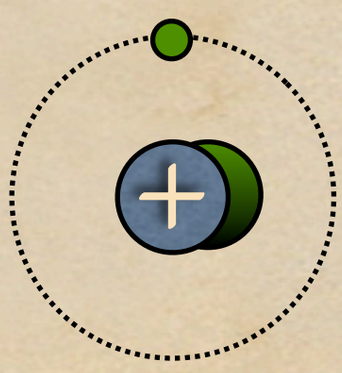
- Isotopes are atoms of the same element that have different masses due to having different numbers of neutrons.
- The atomic mass (weight) on the periodic table is the average of the abundance (percent) of all the isotopes of an element.

H-1



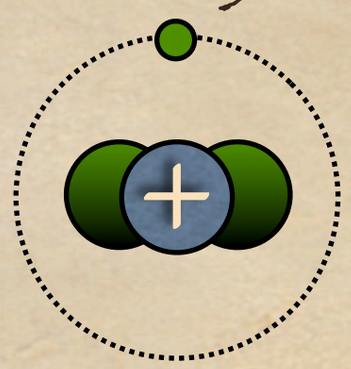
99.985%

H-2



0.014%

H-3



0.001%

Isotopes

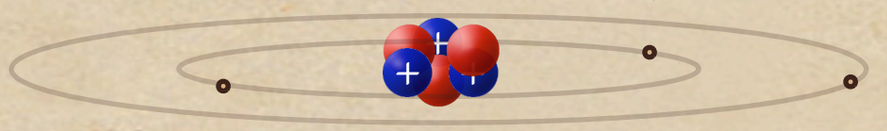
The Atomic Mass of an element is the average of the abundance of all the isotopes of that element.

There are at least 2 isotopes of every element.

Tin has 10 isotopes.

Lithium only has two isotopes:

Lithium - 6



$3\ p^+ + 3\ n^0 = 6$ AMU

Abundance: x 0.07

0.42 AMU

Lithium - 7

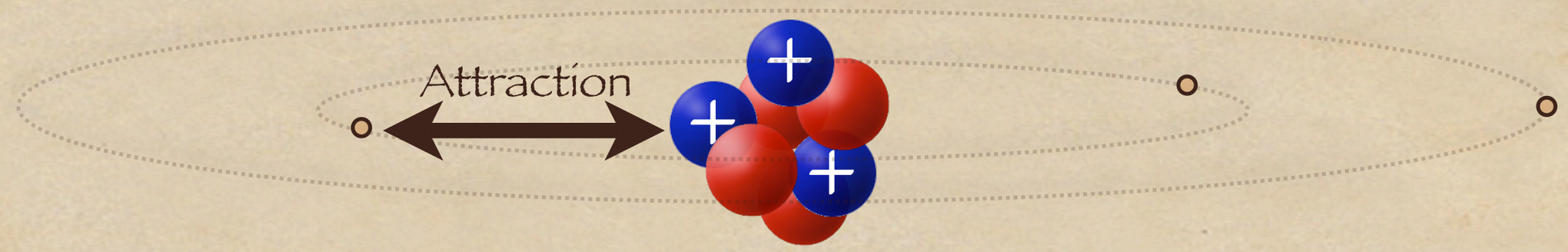
$3\ p^+ + 4\ n^0 = 7$ AMU

x 0.93

6.51 AMU

Atomic Mass of Lithium = 0.42 AMU + 6.51 AMU = 6.93 AMU

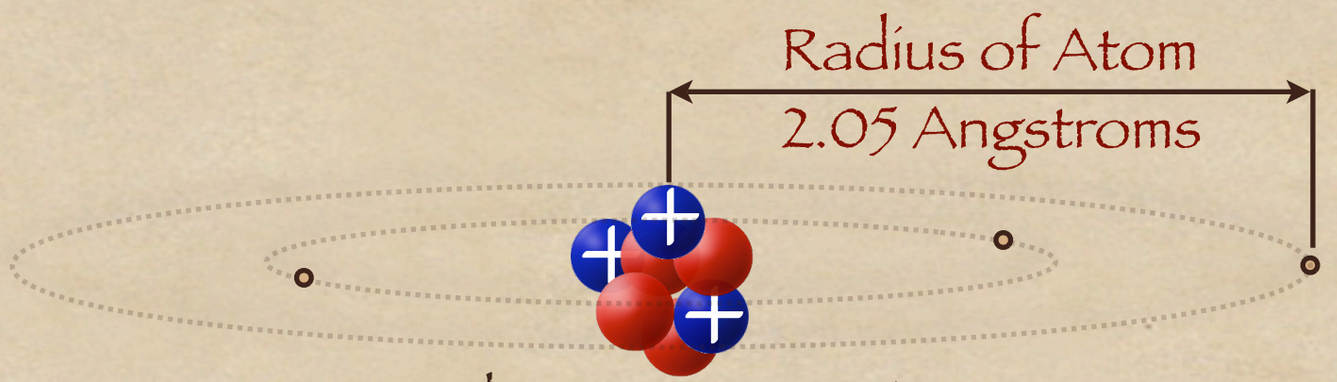
Question: Why do electrons orbit the nucleus?



Answer: The attraction between the + charged protons and the - charged electrons keeps the electrons in obitals and prevents them from flying out of the atom.

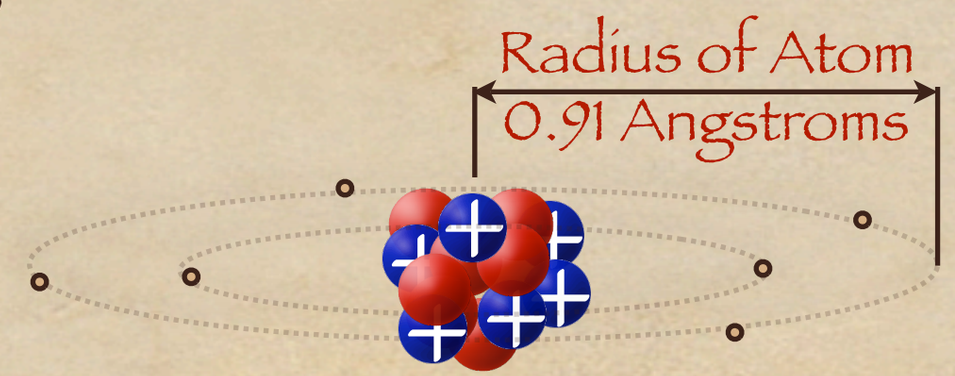
(Opposite electrical charges attract.)

Question: What happens to the force of attraction between the nucleus and electrons when more protons are added to the nucleus?



Lithium atom (3 p^+)

Answer: The attraction becomes greater and the electrons are pulled closer to the nucleus causing the atomic radius to decrease.



Carbon atom (6 p^+)

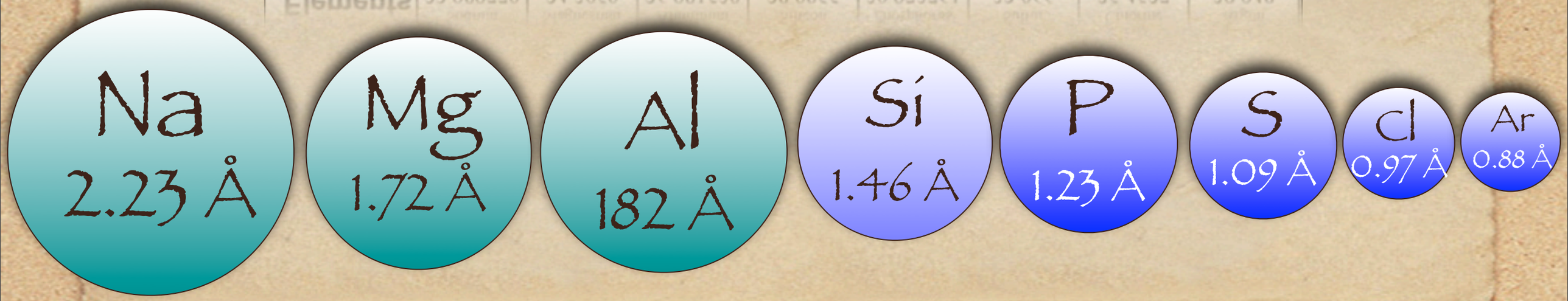
As you go across a period the number of protons increase producing a greater force of attraction between the nucleus and the electrons.

This increase in attraction pulls the electrons closer to the nucleus - causing the atomic radii to decrease.

As protons in nuclei increases

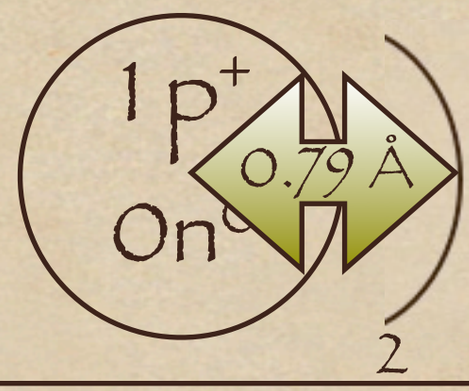
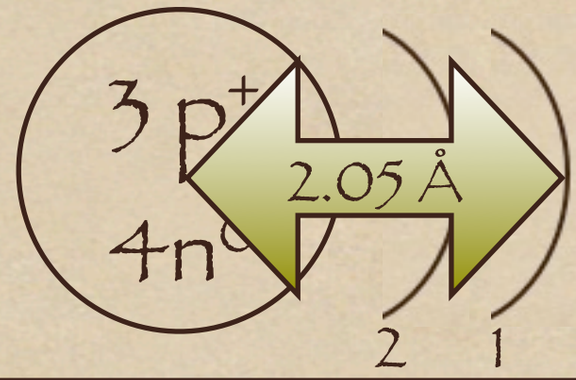
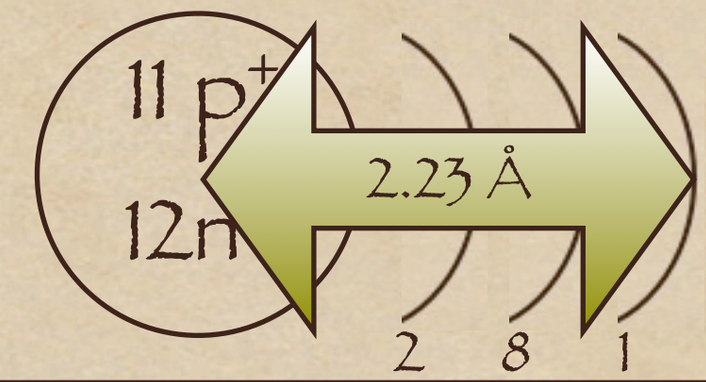
atomic radii decreases

Period 3 Elements	11 **Na** Sodium 22.989770	12 **Mg** Magnesium 24.3050	13 **Al** Aluminum 26.981538	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973761	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948



Question:
What happens to the atomic radii as you go down a group (family) of elements?

Answer:
It increases due to the increase in e^- energy levels.

Group 1A	Bohr Model
1 H 1.008	
3 Li 6.941	
11 Na 22.990	
19 K 39.098