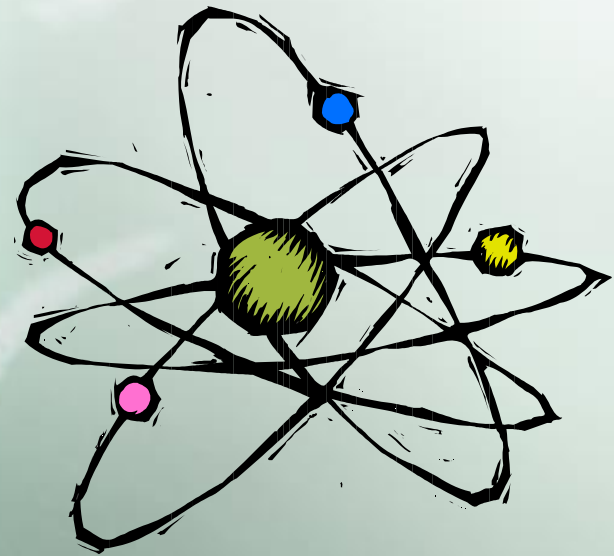


Elements & Atoms



General chemistry
Dr. razaq .Sh . Kh.
PHD . Clinical biochemistry



The atom

molecular structure

electronically distribution

Chemical bonding

Matter...

- All matter, whether living or nonliving, is made of the same type building blocks called **atoms**
- An **atom** is the smallest basic unit of matter
- All atoms have the same basic structure, composed of three smaller particles
 - ▣ **Proton** – *a positively charged particle in an atom's nucleus*
 - ▣ **Neutron** – *a neutral (no charge) particle which has about the same mass as a proton and is also in the nucleus*
 - ▣ **Electron** – *a negatively charged particle found outside the nucleus. Electrons are much, much smaller than proton and neutrons*

An atom refresher

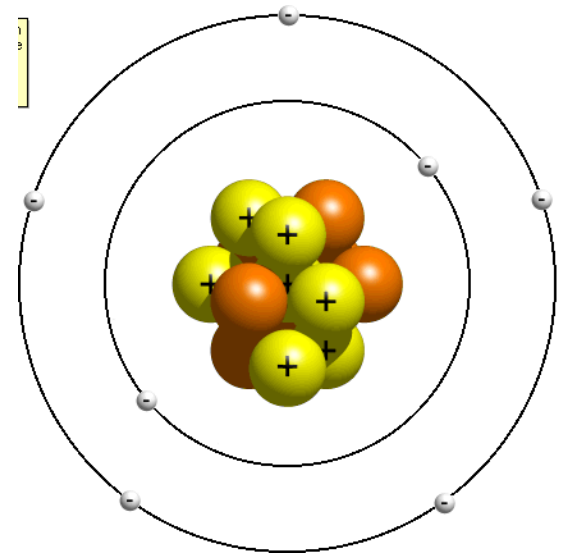
- **Matter** is anything that takes up space and has mass.
- All matter is made of atoms
- Atoms are the building blocks of matter, sort of how bricks are the building blocks of houses.



An atom refresher

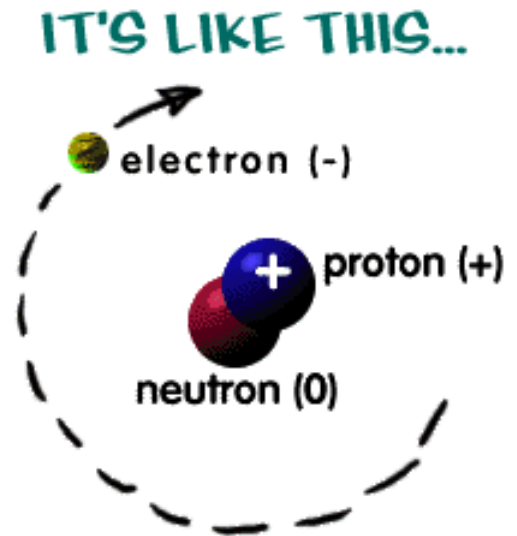
- An atom has three parts:
- **Proton** = positive
- **Neutron** = no charge
- **Electron** = negative

- The proton & neutron are found in the center of the atom, a place called the **nucleus**.
- The electrons orbit the nucleus.



What are elements?

- Elements are the alphabet to the language of molecules.
- To make molecules, you must have elements.
- Elements are made of atoms. While the atoms may have different weights and organization, they are all built in the same way.



Elements...

- Different types of atoms are called **elements**, which cannot be broken down by ordinary chemical means
- Which element an atom is depends on the number of protons in the atom's nucleus
 - ▣ *For example... all hydrogen atoms have 1 proton and all oxygen atoms have 8 protons*
- Only about 25 different elements are found in organisms
 - ▣ *However, atoms of different elements can “link” or bond together to form compounds*

Atoms always have as many electrons as protons.
Atoms usually have about as many neutrons as protons.

Hydrogen



1 proton
1 electron
0 neutrons

Helium



2 protons
2 electrons
2 neutrons

Carbon

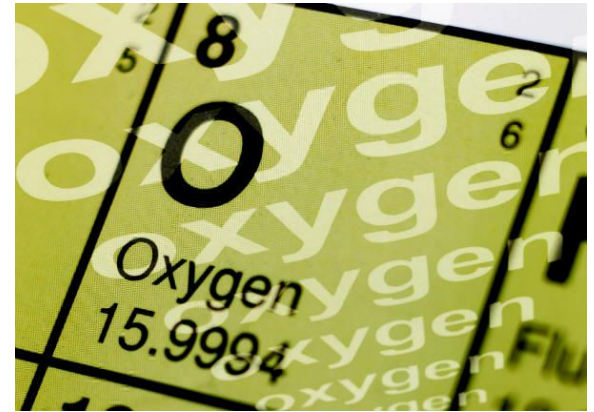


6 protons
6 electrons
6 neutrons

Adding a proton makes a new kind of atom!
Adding a neutron makes an isotope of that atom,
a heavier version of that atom!

More about Elements..

- **Elements** are the building blocks of all matter.
- The periodic table is a list of all of the elements that can build matter. It's a little like the alphabet of chemistry.
- The periodic table tells us several things...



Periodic Table

Atomic Number:

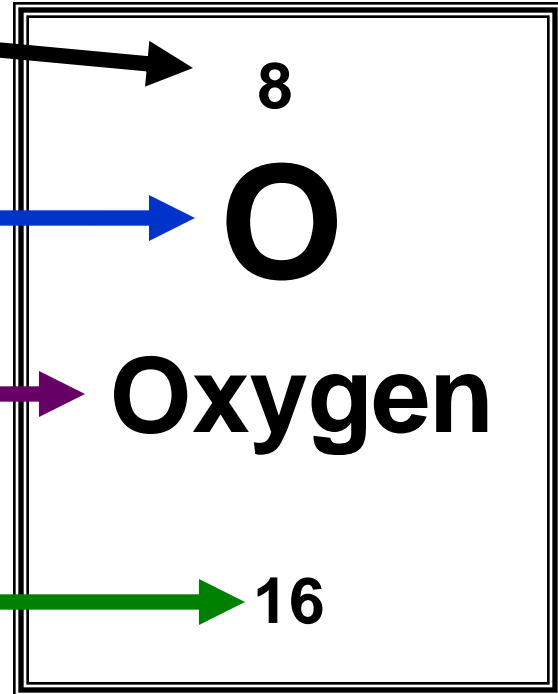
Number of protons and it is also the number of electrons

Element's Symbol:
An abbreviation for the element.

Elements Name

Atomic Mass/Weight:

Number of protons + neutrons.



Elements...

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Isotope

- Elements can have a different number of neutrons.
- This is called an isotope
 - *Carbon 14, Carbon 13, and Carbon 12*

Electron Configurations



Three rules—

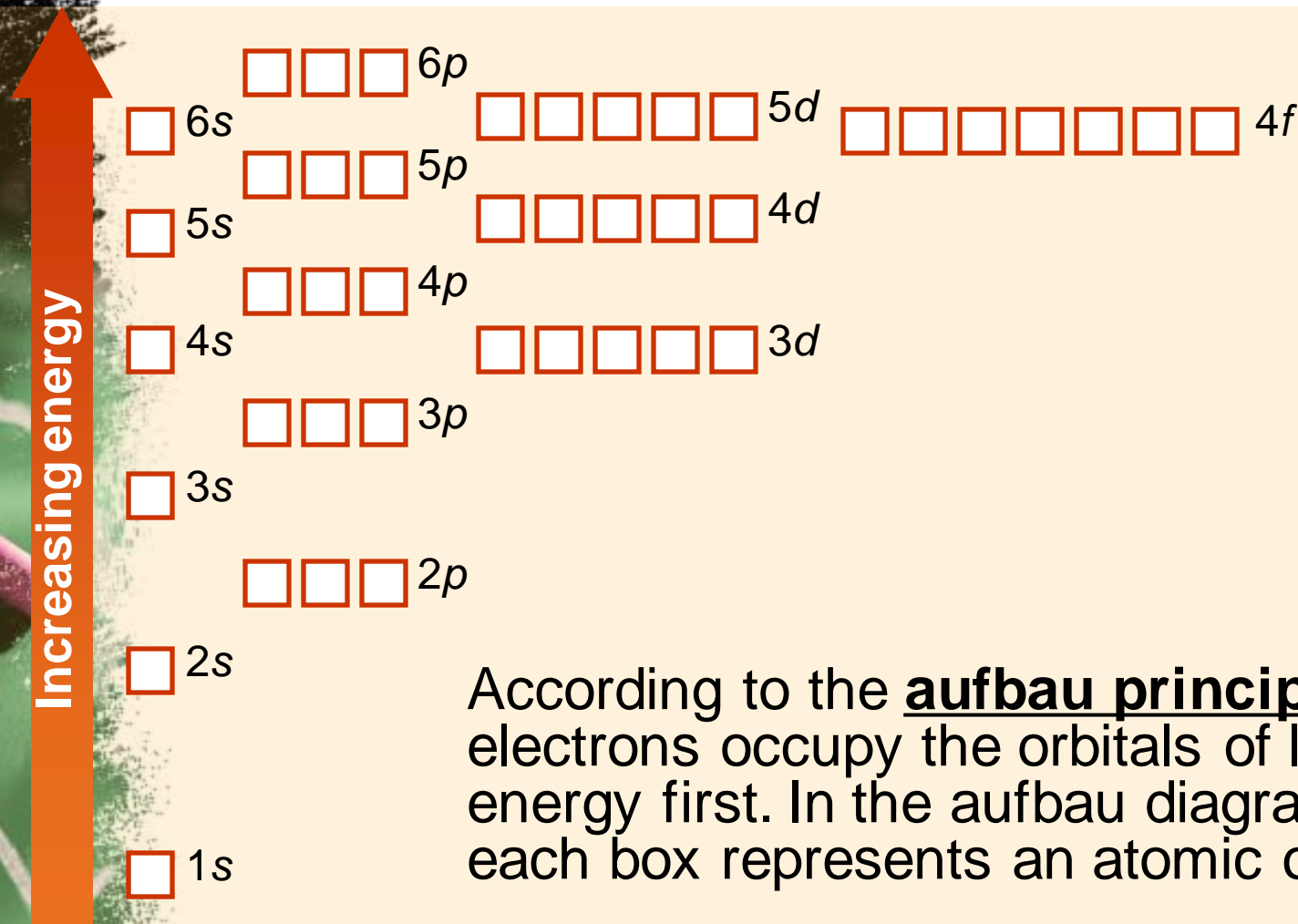
the aufbau principle,

**the Pauli exclusion principle, and
Hund's rule—**

**tell you how to find the electron
configurations of atoms.**

Electron Configurations

Aufbau Principle



According to the **aufbau principle**, electrons occupy the orbitals of lowest energy first. In the aufbau diagram, each box represents an atomic orbital.

Electron Configurations

Pauli Exclusion Principle

Spin is a quantum mechanical property of electrons and may be thought of as clockwise or counterclockwise.

- A vertical arrow indicates an electron and its direction of spin (\uparrow or \downarrow).
- An orbital containing paired electrons is written as $\uparrow\downarrow$.



Electron Configurations

Hund's Rule

According to Hund's rule, electrons occupy orbitals of the same energy in a way that makes the number of electrons with the same spin direction as large as possible.



Electron Configurations

Look at the orbital filling diagram of the oxygen atom.

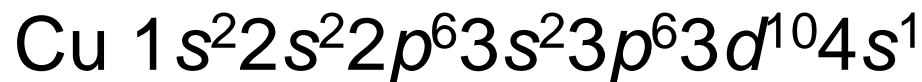
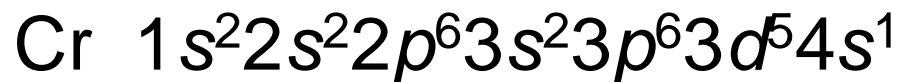
- The 1s orbital has two electrons of opposite spin.

| Electron Configurations of Selected Elements | | | | | | | |
|--|----|----|-----------------|-----------------|-----------------|----|---|
| Element | 1s | 2s | 2p _x | 2p _y | 2p _z | 3s | Electron configuration |
| H | ↑ | □ | □ | □ | □ | □ | 1s ¹ |
| He | ↑↓ | □ | □ | □ | □ | □ | 1s ² |
| Li | ↑↓ | ↑ | □ | □ | □ | □ | 1s ² 2s ¹ |
| C | ↑↓ | ↑↓ | ↑ | ↑ | □ | □ | 1s ² 2s ² 2p ² |
| N | ↑↓ | ↑↓ | ↑ | ↑ | ↑ | □ | 1s ² 2s ² 2p ³ |
| O | ↑↓ | ↑↓ | ↑ | ↑ | ↑ | □ | 1s ² 2s ² 2p ⁴ |
| F | ↑↓ | ↑↓ | ↑↓ | ↑ | ↑ | □ | 1s ² 2s ² 2p ⁵ |
| Ne | ↑↓ | ↑↓ | ↑↓ | ↑↓ | ↑ | □ | 1s ² 2s ² 2p ⁶ |
| Na | ↑↓ | ↑↓ | ↑↓ | ↑↓ | ↑↓ | □ | 1s ² 2s ² 2p ⁶ 3s ¹ |

Electron Configurations

Exceptional Electron Configurations

- The correct electron configurations are as follows:



- These arrangements give chromium a half-filled *d* sublevel and copper a filled *d* sublevel.

Compounds...

□ Atoms form compounds in two ways

1. *Ionic bonds – consists of ions and forms through the electrical force between oppositely charged ions*

■ An ion is an atom that has lost or gained electrons

Cation – an ion that loses electrons so becomes positively charged

Anion – an ion that gains electrons so becomes negatively charged

2. *Covalent bonds – forms when atoms share one or more pairs of electrons*

■ A molecule consists of two or more atoms held together by covalent bonds

Why elements bond the way they do...

- All atoms want 8 electrons in their outer most energy level (shell) This is called the **octet rule**.
- That is why they do what they do
 - *Ionic bonds – gain or lose electrons*
 - *Covalent share electrons*
- How do we identify each type
 - *Ionic compound – metal + non-metal*
 - *Covalent compound – non-metal + non-metal*



Water's Unique Properties...

- The STRUCUTRE of the water molecule gives water its unique properties
- Water is a **polar** molecule, which means that it has a region with a slight negative charge (the oxygen atom) and a region with a slight positive charge (the hydrogen atoms)
- The oppositely charged regions of water molecules interact to form **hydrogen bonds**
 - *Hydrogen bond is an attraction between a hydrogen atom and a negative atom*

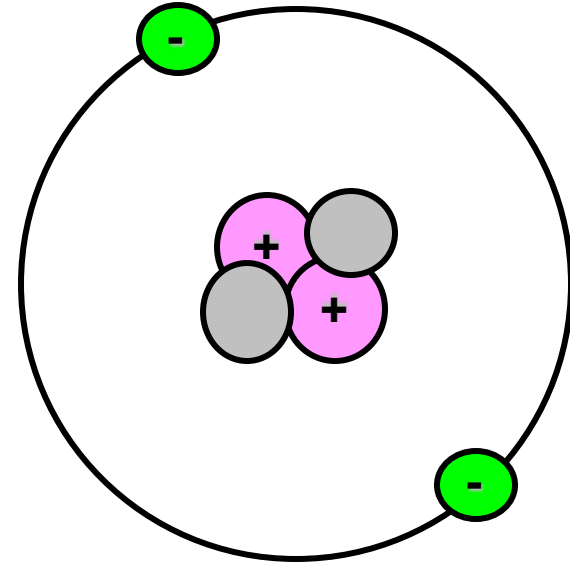
Atom Models

- There are two models of the atoms we will be using in class.
- Bohr Model
- Lewis Dot Structure



Bohr Model

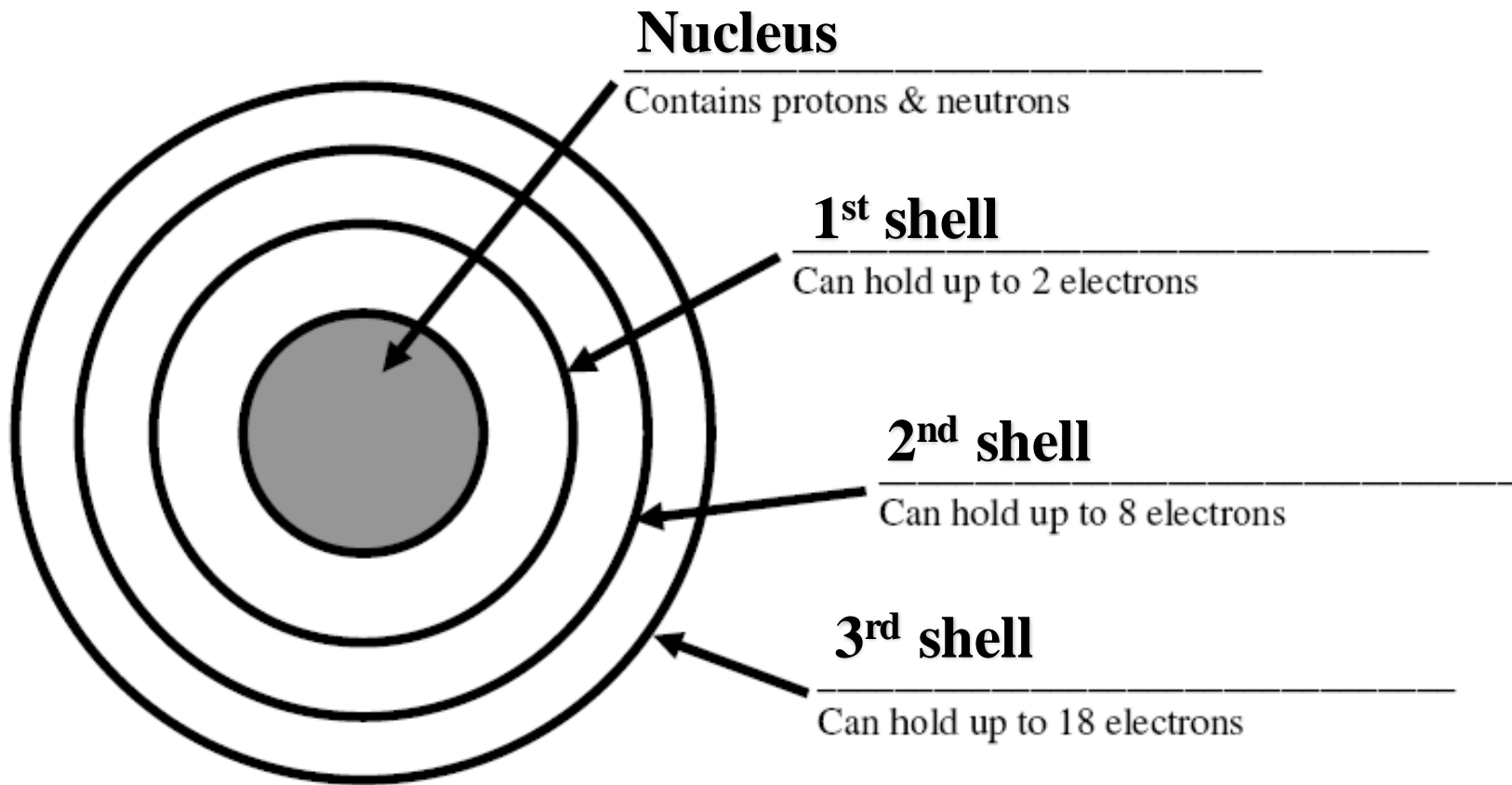
- The Bohr Model shows all of the particles in the atom.
- In the center is circles. Each circle represents a single neutron or proton. Protons should have a plus or P written on them. Neutrons should be blank or have an N.
- In a circle around the nucleus are the electrons. Electrons should have a minus sign or an e.



Electrons have special rules....

- You can't just shove all of the electrons into the first orbit of an electron.
- Electrons live in something called shells or energy levels.
- Only so many can be in any certain shell.





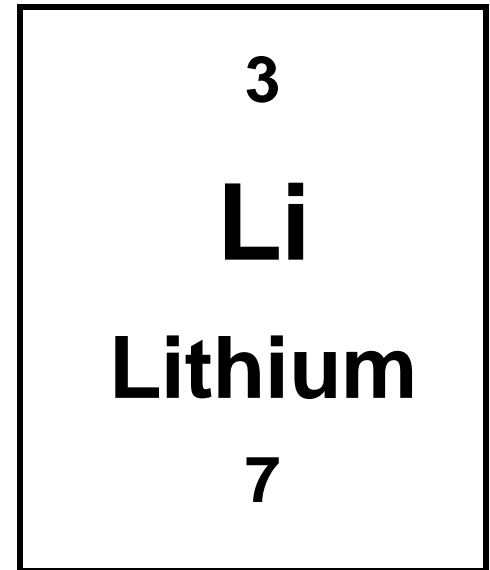
Electrons have special rules....

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- Electrons live in something called shells or energy levels.
- Only so many can be in any certain shell.
- The electrons in the outer most shell of any element are called **valance electrons**.

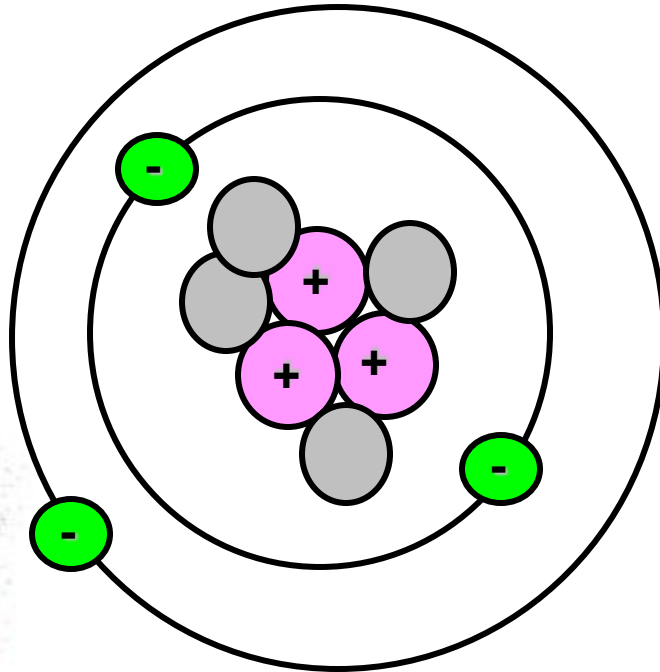


So let's try it....

- How to draw a Lithium atom
- First, look at the Periodic Table
- Second, determine the number of protons (Look @ the atomic number)
- Then determine the number of neutrons (Atomic mass – atomic number)
- Then determine the number of electrons (Look @ the atomic number)



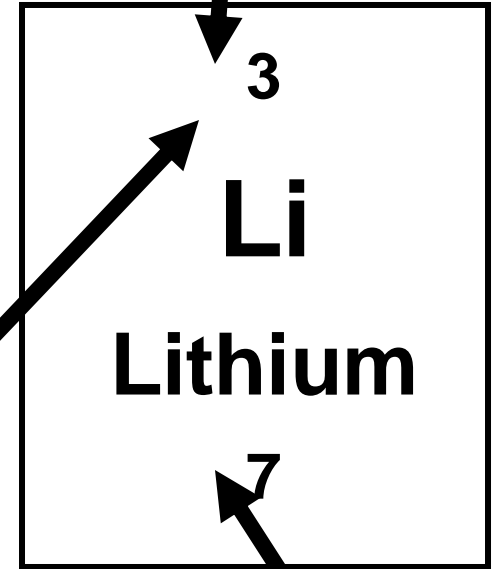
So let's try it....



Electrons = 3

2 in the 1st shell, 1 in the 2nd shell

Protons = 3

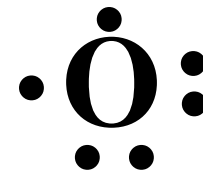
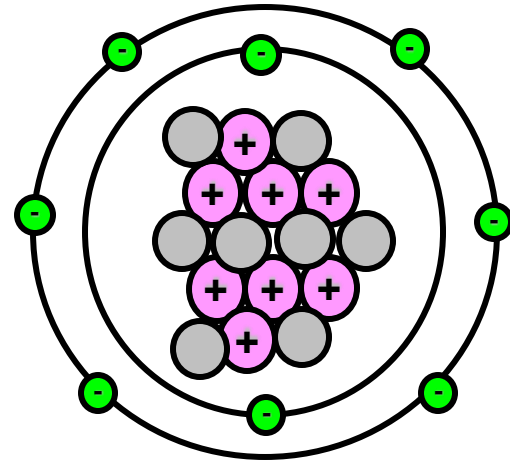


Neutrons = 4

(7-3=4)

Lewis Dot Structure

- The Lewis Dot Structure is a bit different from the Bohr model.
- It only shows the element symbol and its outer most electron shell.



How to...

1. Write the symbol.
2. Start on the right hand side, working your way clockwise around the symbol.
3. Try Lithium



Your activity...

- Using the beans (Lentils are electrons, Lima Beans are protons, and kidney beans are neutrons), create a Bohr model , and then a Lewis dot structure model of each of the first 20 elements. After you have created each model, draw each model on your chart.
- Hint to make a chart, use a burrito fold, then fold the top down by 1 ½ inches. Unfold, you now have 3 columns. Label the columns: element, Bohr model, Lewis Dot.