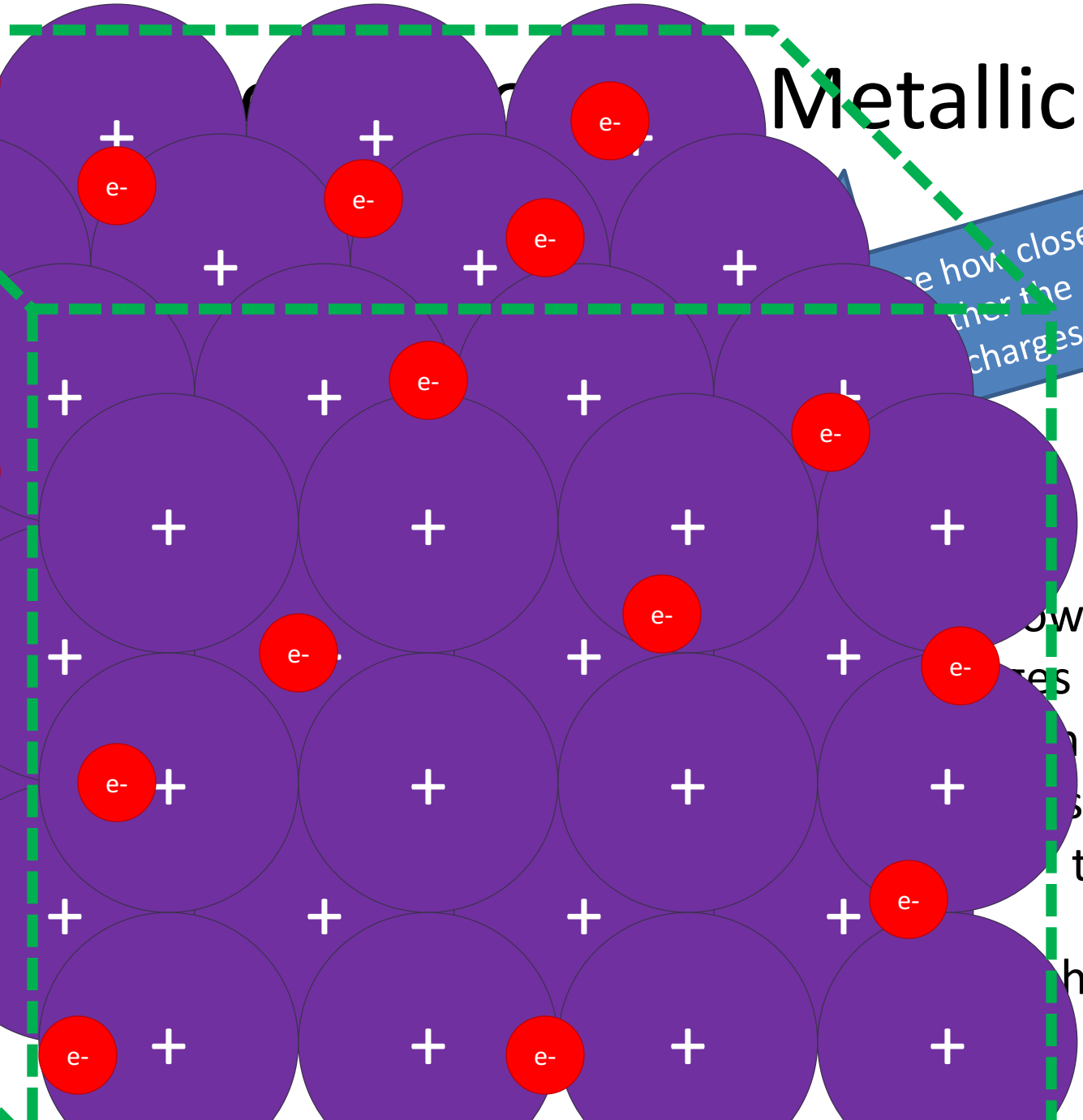
Properties of Metallic Bonding

Why do metals have their properties?

Metallic Bonding Slides

- After viewing each slide, discuss and summarize the information on the slide with your group members.

Metallic Crystal



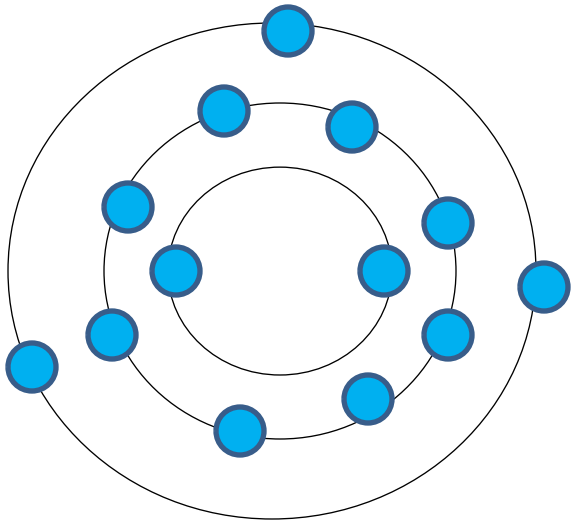
What do you notice about the behavior of the electrons?

w can this be? Like
s repel each other.
a crystal made of
itive charges stay
together?

have a closer look.

Electron Sea Model

Let's Look at Aluminum: $1s^2\ 2s^2 2p^6\ 3s^2 3p^1$



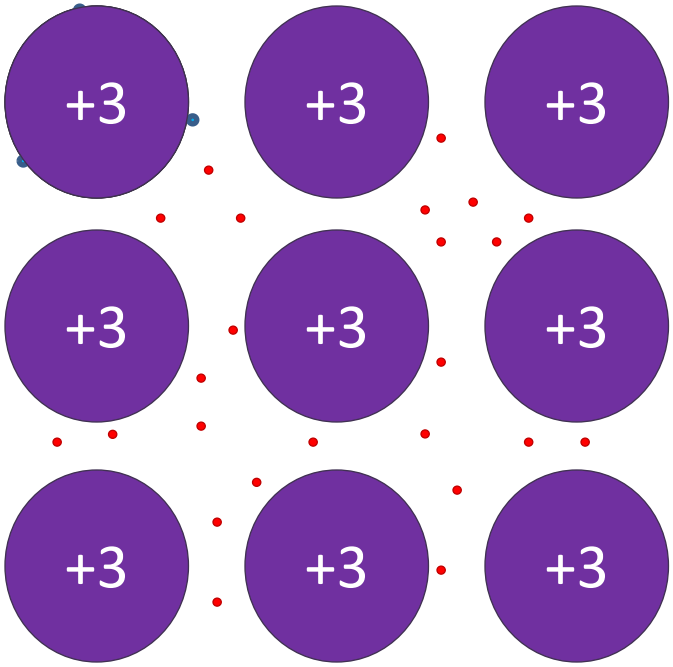
How many valence electrons does Al have? **3**

An atom is most stable with 8 valence electron. So is it easier to lose 3 or to find 5 (to get to 8)? **Lose 3**

Is this a ***cation*** or ***anion***? **Cation**

What charge will the atom have after losing 3 ***negative*** electrons? **+3**

Electron Sea Model



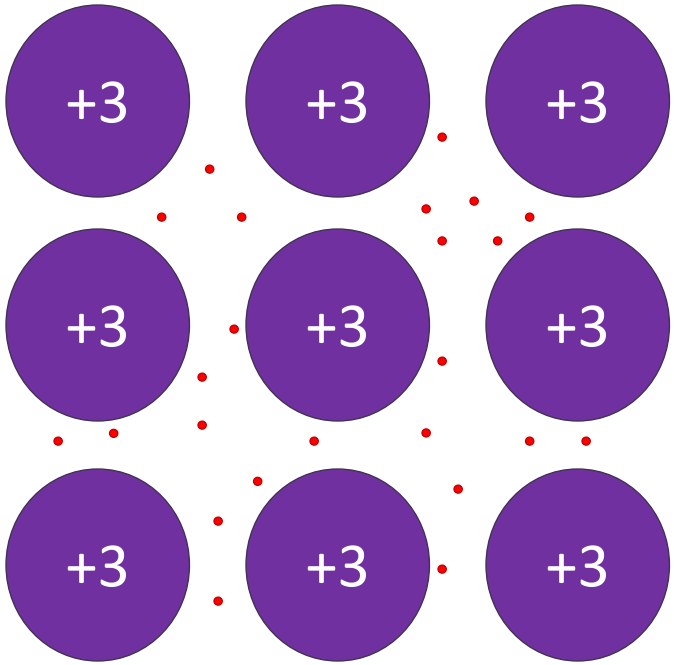
We call these
"delocalized electrons".

Each Aluminum atom gives up 3 valence electrons to the "electron sea".

The metal cations vibrate in place; the electrons freely flow between the metal cations, giving metals their properties.

Electron Sea Model

These delocalized electrons are strongly attracted to the cations; holding the crystal together.



We call these ***"delocalized electrons"***.

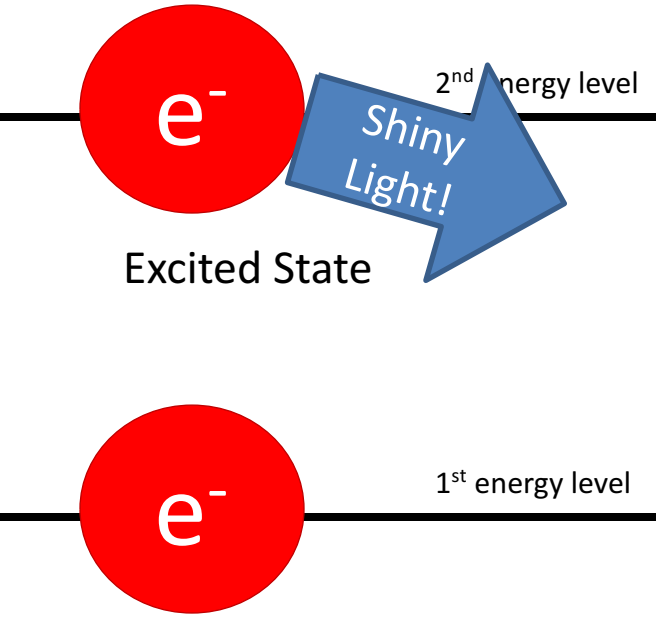
The electrons ***flow in-between the cations***, insulating them, ***preventing two positive charges from touching*** each other and repelling.

The electrons are acting as "grease" in-between the cations, preventing them from touching each other.

What are the Properties of Metals?

- Shiny
- Good conductors of heat and electricity
- Malleable (can be shaped with a hammer)
- Ductile (can be shaped into a wire)

Why are Metals Shiny?

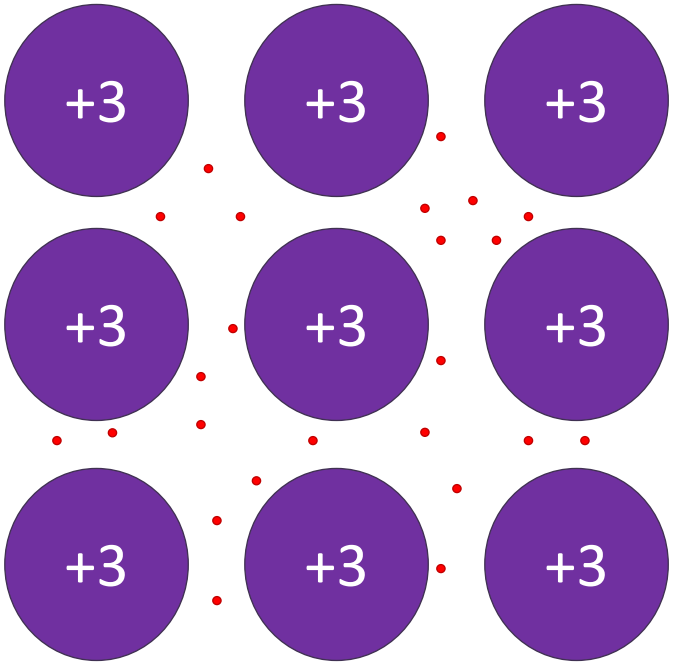


Recall what happens to electrons when they absorb energy: ***They jump up in energy level***.

The electrons then re-emit that energy as visible light, ***jumping back down in energy level***.

Delocalized electrons readily absorb and re-emit light energy; giving metals their shine.

Why are Metals Good Conductors?

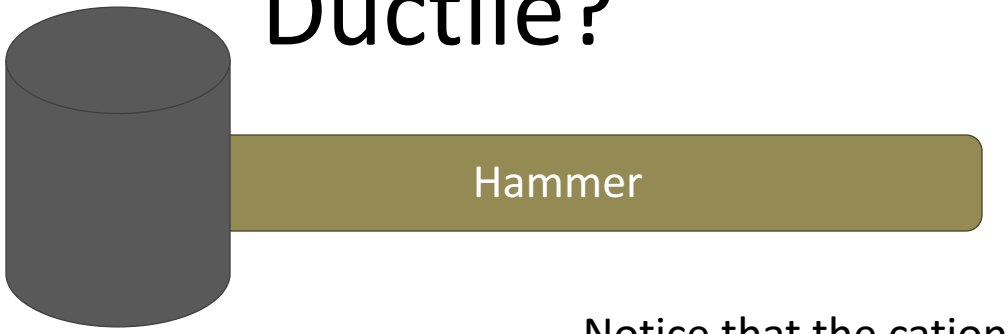


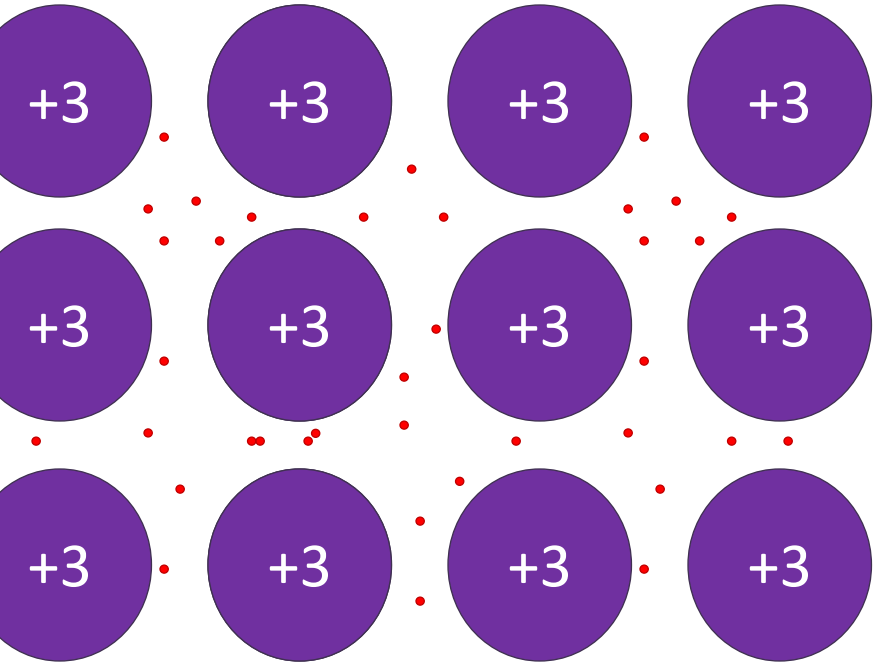
Because ***delocalized electrons move through the metallic crystal***…

…***they can carry electric current and heat***, making them good conductors.

Why are Metals Malleable and Ductile?

Lets watch what happens when we strike the metal with a hammer.





Notice that the cations slide past each other; they shifted past each other.

The delocalized electrons are always there, ***holding together any shifting cations***.

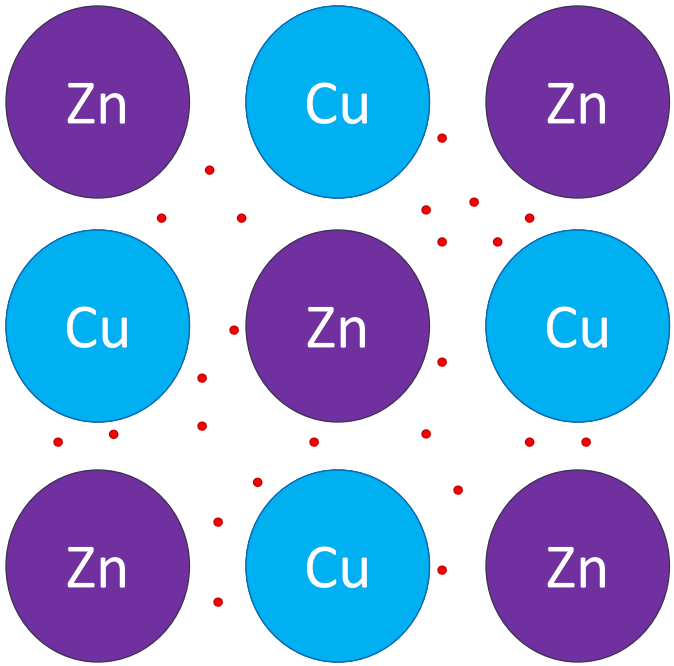
The metal is held together due to the constant attraction of the cations to the electron sea.

Metallic Bonding Model

- Obtain a model. What do the large stationary beads represent? The small silver beads?
- With your group, discuss:
  - How the electrons move when you tilt the model *(please don't spill any beads)*
  - The properties of metals (shiny, etc.)

What are Alloys?

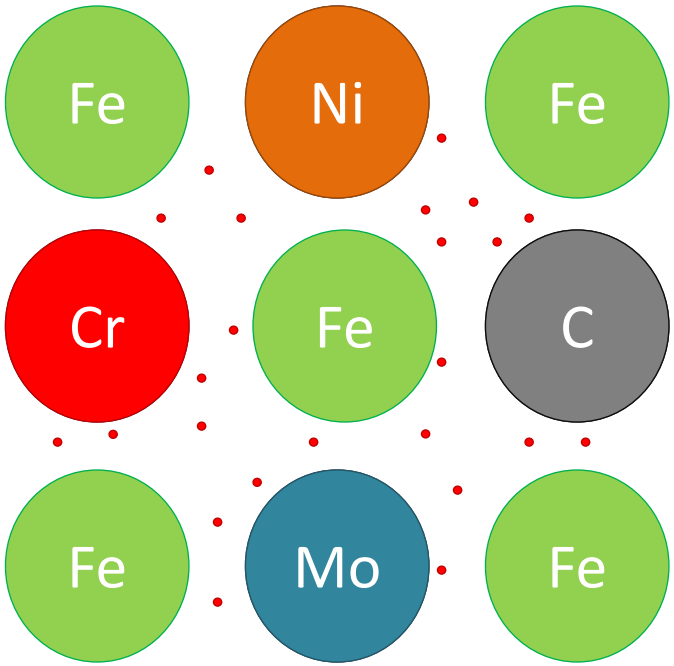
Alloys are mixtures of two or more metals.



Brass is an alloy of zinc and copper.

Surgical Steel is an alloy of iron, chromium (for scratch resistance), nickel (for a smooth, polished finish), carbon (adds hardness), and molybdenum (adds hardness).

They can also contain small amount of non-metals.



Back to the Models You Made…

- We are going to make an ***alloy*** by changing the composition of the metal represented by our model.
  - Observe the alloy model (up front)
  - We will switch out some of the large beads
- Discuss: How might this change the properties of your metal?