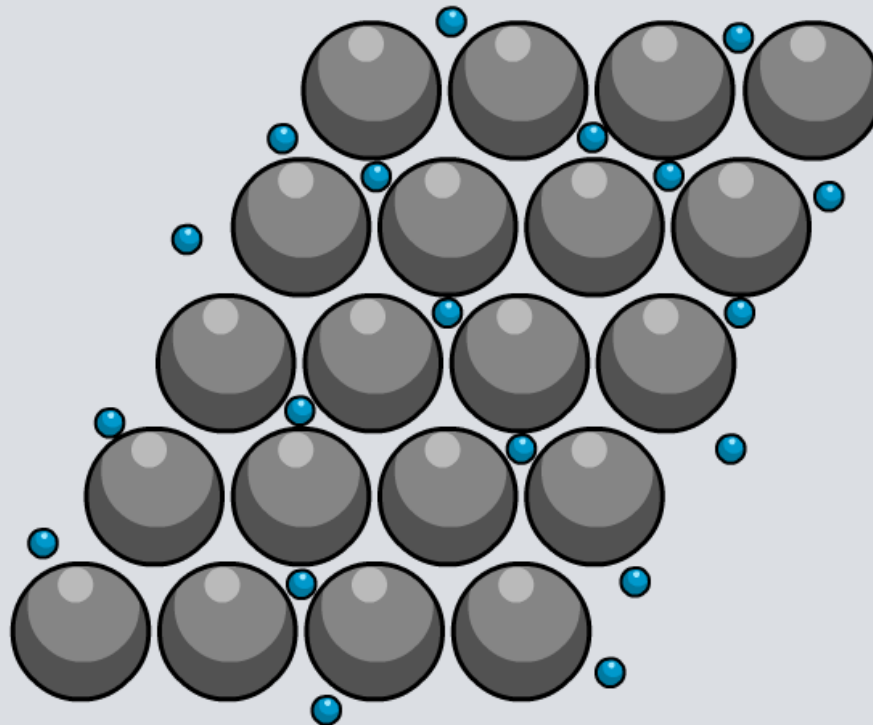


## Metallic Bonding



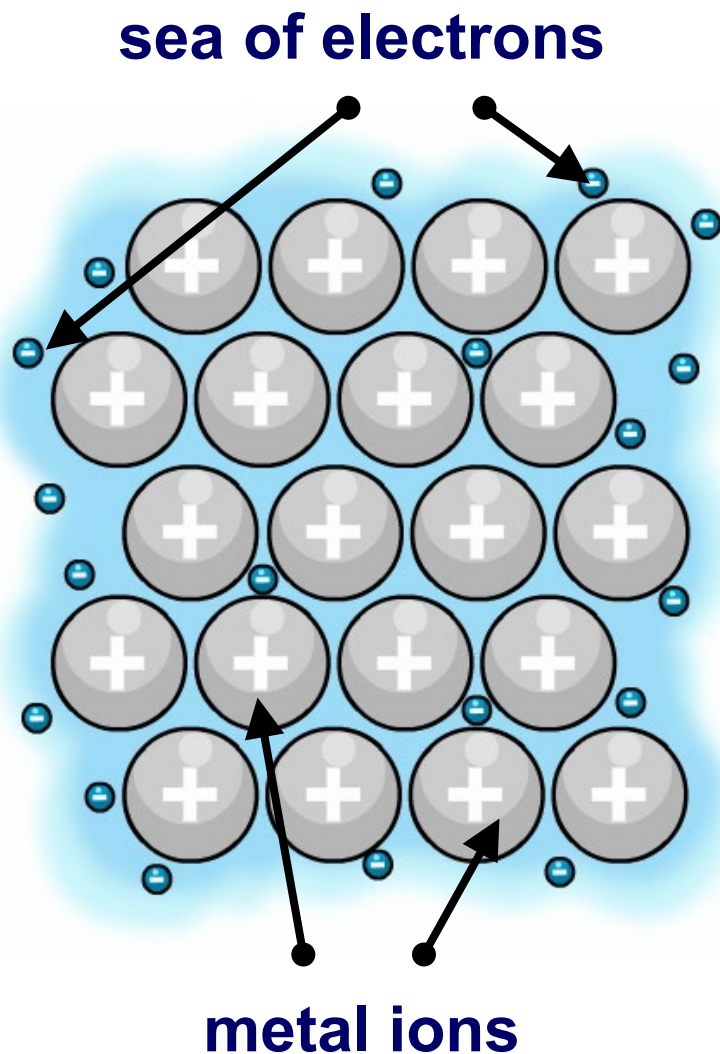
# What is the structure of metals?

The atoms in a pure metal are in tightly-packed layers, which form a regular **lattice** structure.

The outer electrons of the metal atoms separate from the atoms and create a '**sea of electrons**'.

These electrons are **delocalized**, and so are free to move through the whole structure.

The metal atoms become positively charged ions and are attracted to the sea of electrons. This attraction is called **metallic bonding**.

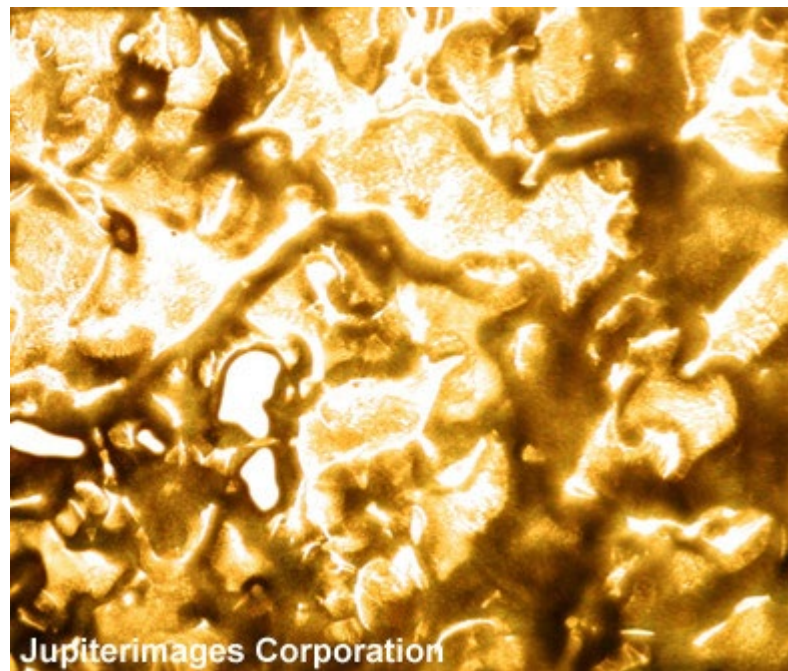


# Why do metals have high melting points?

The properties of metals are related to their structure.

Metals often have high melting points and boiling points. Gold, for example, has a melting point of  $1064\text{ }^{\circ}\text{C}$  and a boiling point of  $2807\text{ }^{\circ}\text{C}$ .

This property is due to the strong attraction between the positively-charged metal ions and the sea of electrons.

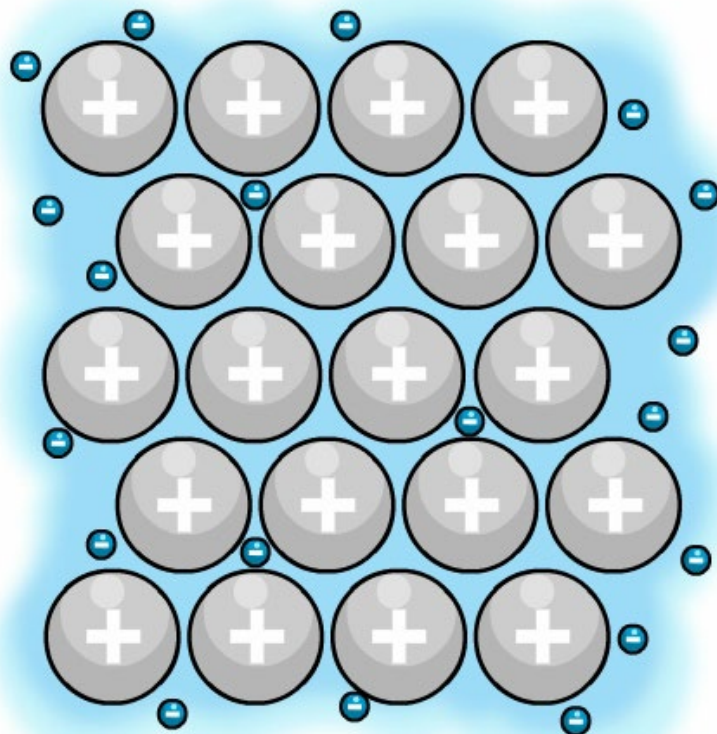


In metal extraction and other industrial processes, furnaces often run continuously to maintain the high temperatures needed to work with molten metals.



# How do metals conduct heat and electricity?

Delocalized electrons in metallic bonding allow metals to conduct heat and electricity.



  
**heat**

For example, when a metal is heated, the delocalized electrons gain kinetic energy.

These electrons then move faster, and so transfer the gained energy throughout the metal.

This makes heat transfer in metals very efficient.

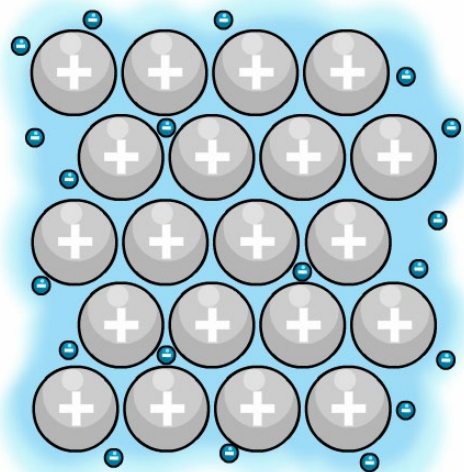
Delocalized electrons also conduct electricity through metals in a similar way.



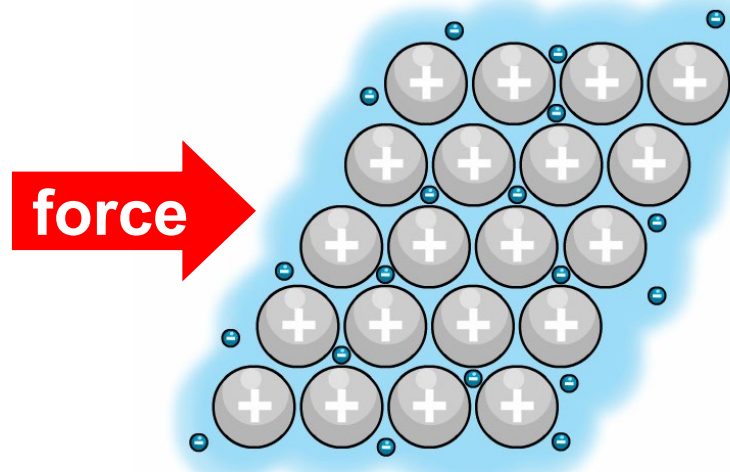
# Why are metals strong?

Metals are usually strong, not brittle. When a metal is hit, the layers of metal ions are able to slide over each other, and so the structure does not shatter.

**metal before it is hit**



**metal after it is hit**



The metallic bonds do not break because the delocalized electrons are free to move throughout the structure.

This also explains why metals are malleable (easy to shape) and ductile (can be drawn into wires).

# Metallic bonding

