# Chemistry 1010

Metals

#### Introduction

## What are are some of the common materials that we make things out of?





Where do these materials come from?

What are some of their advantages and disadvantages?

Let's focus in on metals. What are some of their properties?



solid at room temp (except mercury) high luster (shiny) good conductors of heat and electricity malleable (can be hammered or rolled into sheets) ductile (can be drawn into wires) high melting points high density

What are some metals that you can think of that are used in everyday life?

copper, iron, steel, aluminum, gold, platinum, zinc, tin, nickel, lead, chromium, mercury, bronze, brass, silver

Notice that metals are either elements or alloys.

elements: copper, iron alloys: bronze, steel

Are we likely to make things out of pure elements?

no – metals usually come in mixtures, and we create alloys on purpose to improve the properties of the metal

What will happen if metals combine with other elements to form compounds?









metal nonmetal ionic compound

They form salts – no longer have metallic properties.

What things would disappear from our society if we had no metals?



knives, scissors, razors, etc anything with a sharp edge



tools – shovels, hoes, hammers, pliers, bulldozers



everything electrical – lights, motors, appliances computers, television, etc



screws, bolts, nails, hinges, pins, needles, etc



#### engines – cars, trains, planes, etc



#### pans, utensils, etc



#### mirrors, telescopes, etc



#### skyscrapers, bridges, etc



#### firearms

rms

#### Name that metal

Which vial contains which metal?

#1 aluminum
#2 chromium
#3 copper
#4 lead
#5 magnesium
#6 iron
#7 tin
#8 silver
#9 antimony
#10 zinc

#### Where do metals come from?

Only a few metals are found in the earth as metals rather than as ionic compounds.



gold s

silver

copper

platinum

iron\*

All of the rest are found as ores, which are naturally occurring ionic compounds.



copper ore

iron ore

lead ore

aluminum ore

#### Metals ores are usually oxides, sulfides, or carbonates.



### CuO, CuCO<sub>3</sub>











 $Al_2O_3$ 

The process of changing the metal ore into metal is called smelting.





What is needed besides to ore to produce the metal? something to combine with the nonmetal in the ore in this case, carbon

What is happening in this reaction?

 $2 \text{ Fe}_{2}\text{O}_{3} + 3 \text{ C} \longrightarrow 4 \text{ Fe} + 3 \text{ CO}_{2}$ 

smelting of iron ore to make iron



What else could be used to combine with the nonmetal?

$$WO_3 + 3H_2 \longrightarrow W + 3H_2O$$
  
Tungsten Beads

hydrogen gas – more expensive than carbon, but works better used with more expensive metals

$$Cr_2O_3 + 2 AI \longrightarrow 2 Cr + Al_2O_3$$



Sometimes the best way to obtain an expensive metal is to sacrifice a cheaper one.

#### What other method is used if no smelting agent can be found?



#### electrolysis

 $2 \operatorname{Al}_2 \operatorname{O}_3 \rightarrow 4 \operatorname{Al} + 3 \operatorname{O}_2$ 

#### What is the biggest drawback of metals?

## corrosion – they react with oxygen or sulfur to go back to their salt form

#### What is happening in these reactions?

4 Fe + 3  $O_2 \rightarrow 2 Fe_2O_3$  iron turns to rust



Iron reacts slowly with oxygen in the air to form rust. This reaction is much faster in the presence of salt water.

Since there is no oxygen in space, iron meteorites were the first known source of iron metal.

#### $4 \text{ Al} + 3 \text{ O}_2 \longrightarrow 2 \text{ Al}_2 \text{ O}_3$

#### aluminum turns to aluminum oxide



Other metals such as aluminum undergo a similar reaction.

However, unlike rust, aluminum oxide is tough and durable, protecting the rest of the metal from oxygen.



#### silver tarnishes



Silver doesn't react with oxygen, but it does react with sulfur compounds like H<sub>2</sub>S.

When you polish silver, you are dissolving and wiping away the silver (I) sulfide.