

# The Blast Furnace

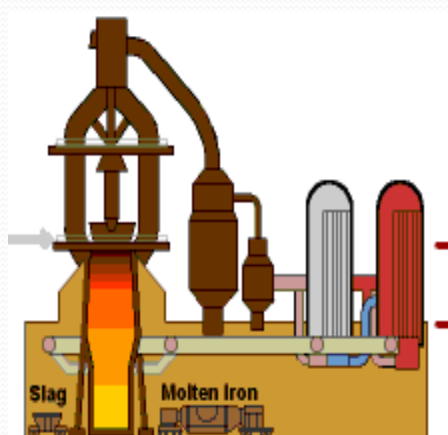
Sam & Dave

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## What is a Blast furnace?

- The purpose of a blast furnace is to reduce and convert iron oxide (**haematite**) into liquid iron.
- The blast furnace is a huge, steel stack lined with refractory brick.
- Iron ore, coke** and **limestone** are put into the top, and preheated air is blown into the bottom.



**Blast Furnace**  
Produces molten pig iron from iron ore.

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### Reactivity Series

The diagram shows a vertical list of metals: Potassium, Sodium, Calcium, Magnesium, Aluminum, Zinc, Iron, Tin, Lead, Copper, Silver, and Gold. A blue arrow on the left points upwards, indicating increasing reactivity. Brackets on the right group the metals into two extraction methods: 'Extracted by Electrolysis' for Potassium through Aluminum, and 'Extracted by Carbon' for Zinc through Gold. Dashed arrows point from 'carbon' to Zinc and from 'hydrogen' to Lead.

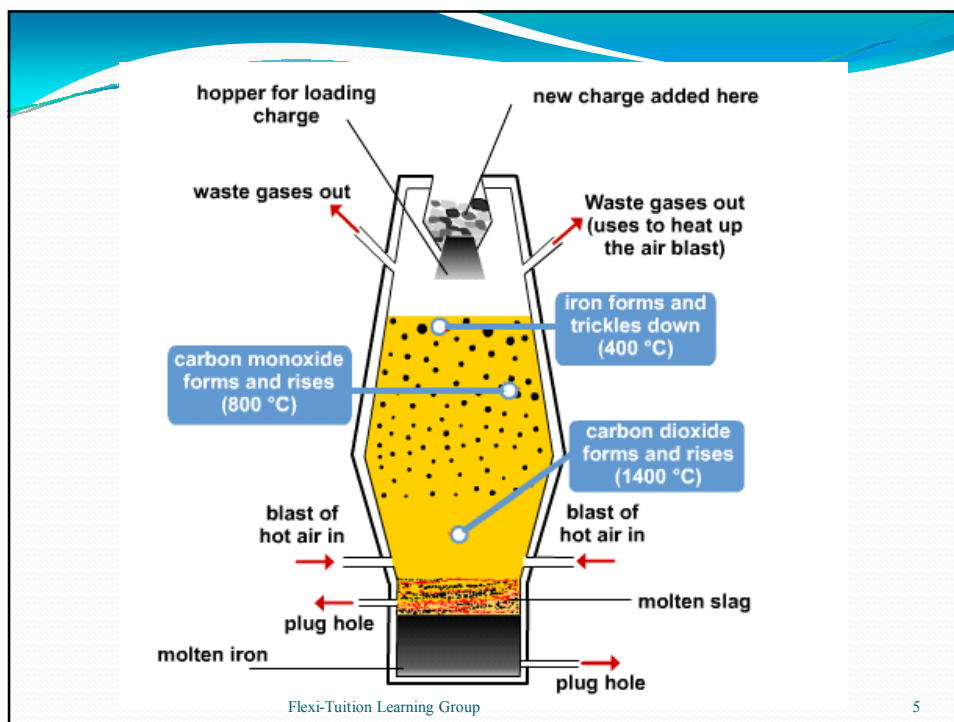
Metal	Extraction Method
Potassium	Extracted by Electrolysis
Sodium	
Calcium	
Magnesium	
Aluminum	
Zinc	Extracted by Carbon
Iron	
Tin	
Lead	
Copper	
Silver	
Gold	


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### Why does Iron have to be extracted in a Blast furnace?


- All metals can be extracted by electrolysis. However, this method is costly as it needs to use much electrical energy.
- Iron can be extracted by the blast furnace because it can be displaced by carbon.

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## The Method



Three substances are needed to enable the extraction of iron from its ore. The combined mixture is called the **charge**.

**Iron ore, haematite** - often contains sand with iron oxide,  $\text{Fe}_2\text{O}_3$ .

**Limestone** (calcium carbonate).

**Coke** - mainly carbon

The charge is placed in a giant chimney called a **blast furnace**. The blast furnace is around 30 metres high and lined with fireproof bricks. Hot air is blasted through the bottom.

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## Three Steps. five Equations

### Step 1: The formation of CO

- 2 equations involved to produce CO (carbon monoxide)

### Step 2: Reduction of iron ore

- 1 equation involved to obtain pure iron.

### Step 3: Removal of sand

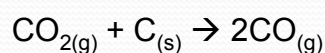
- 2 equations involved to remove the impurities.

## Step 1: The formation of CO

- **Oxygen in the air reacts with coke to give carbon dioxide:**

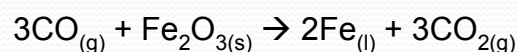


- **Carbon dioxide produced in 1 + 2 react with more coke to produce carbon monoxide:**



## Step 2: Reduction of Iron Ore

- The carbon monoxide reduces the iron in the ore to give molten iron:



- The iron formed melts under the high temperature, and runs down to the bottom of the furnace where it is tapped off as **cast iron** or **pig iron**.

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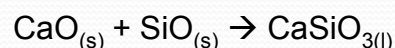
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## Step 3: Removal of Sand

- The limestone breaks down to form carbon dioxide:



- The very basic quicklime reacts with the acidic SiO<sub>2</sub> to form calcium silicate, commonly known as **slag**:



- The molten slag runs to the bottom of the furnace. As it is less dense than and immiscible with iron, it floats on top of the molten iron and can be tapped off. Sand can be used for road building, foundations and cement making.

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