

# The extraction of iron

## ■ Iron: an essential metal in history

**Iron** (Fe) is the 26<sup>th</sup> element on the periodic table and has been used by humans for more than 5,000 years. It is one of the most abundant metals on Earth, making up about 5.6% of the Earth's crust and forming almost the entire **core**. Historically, iron gave societies a huge advantage: those who could shape it into weapons, tools, or other objects gained economic and political power. Over time, iron became a symbol of strength and progress, leading to the Iron Age, when human technology and **craftsmanship** greatly advanced.

## ■ Iron in modern life and industry

Today, iron remains the most important metal for human society. It is used to produce steel, which has countless applications in construction, transportation, and manufacturing. Iron is also vital for living organisms: in plants, it helps produce chlorophyll, and in humans, it is crucial for blood and the vascular system. Each year, more than 500 million tonnes of new iron and 300 million tonnes of recycled iron are produced worldwide. This production relies on large reserves of iron, exceeding 100 billion tonnes, mainly from ores such as:

- **Hematite** ( $\text{Fe}_2\text{O}_3$ ) – mostly iron and oxygen, but may contain small amounts of titanium, aluminum, or silica;
- **Magnetite** ( $\text{Fe}_3\text{O}_4$ ) – iron and oxygen; may include magnesium, titanium, or manganese;
- **Limonite** ( $\text{FeO}(\text{OH}) \cdot n\text{H}_2\text{O}$ ) – iron and water/oxygen; often contains silicon, aluminum, or manganese.

Other trace elements sometimes present in iron ores include phosphorus, sulfur, and chromium, which can affect the quality of the steel made from the ore.



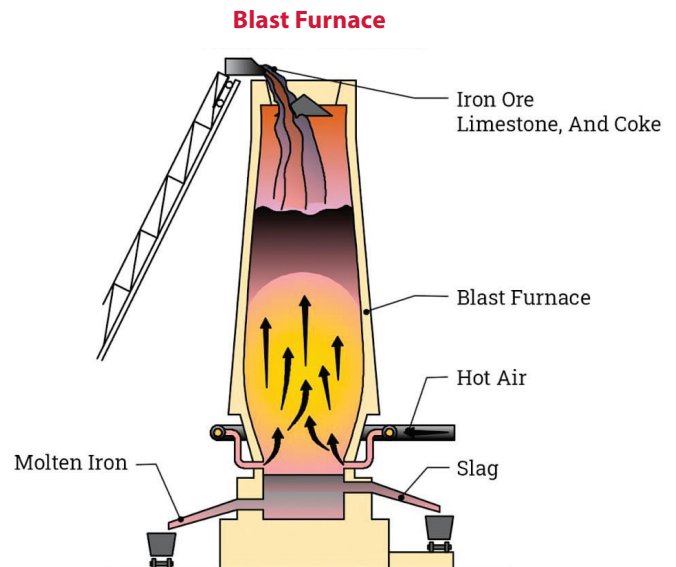
Limonite



Hematite



Magnetite



## ■ The process of extraction

- **Mining:** Iron ores are mined from the Earth.
- **Crushing and grinding:** the ores are crushed into small pieces and ground into a fine powder.
- **Concentration / beneficiation:** impurities like silica, **clay**, and sand are removed to increase the iron content. Methods include magnetic separation or flotation.
- **Calcination / roasting (optional):** some ores are heated to remove water and convert iron compounds into oxides.
- **Reduction in a blast furnace:**
  - the concentrated ore is mixed with coke (carbon) and limestone ( $\text{CaCO}_3$ );
  - hot air is blown into the furnace, allowing the carbon to reduce iron oxides to molten iron;
  - **limestone** reacts with impurities to form **slag**, which floats on top of the molten iron.
- **Collection of molten iron:** the molten iron (also called pig iron) is **tapped** from the bottom of the furnace.

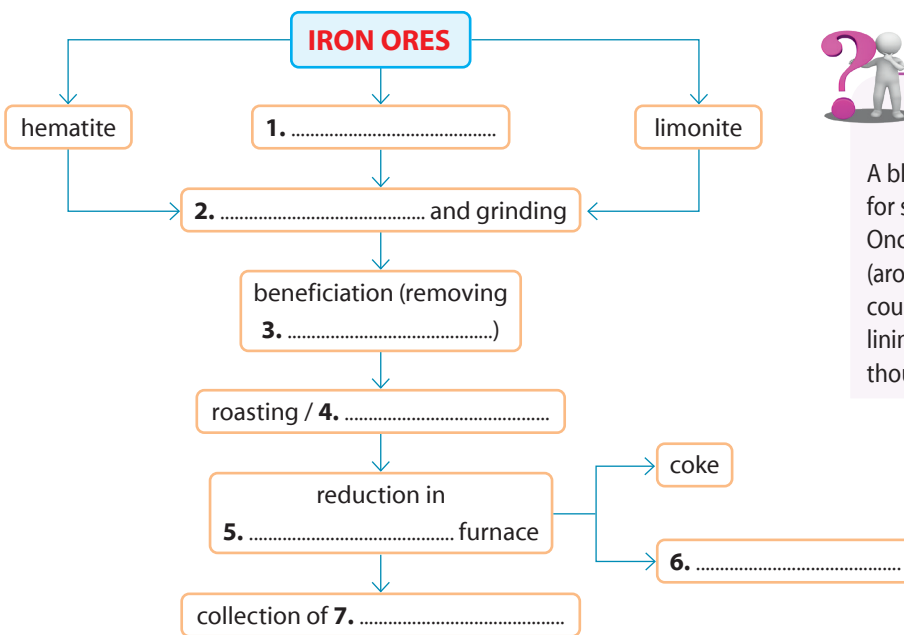
**clay:** *argilla*  
**core:** *nucleo*  
**craftsmanship:** *artigianato*  
**limestone:** *calcare*

**to mine:** *estrarre (minerali)*  
**roasting:** *cottura*  
**slag:** *scoria*  
**to tap:** *estrarre, prelevare*

**1** Match the beginnings and endings.

- |  |                          |   |
|--|--------------------------|---|
| 1. Iron is the 26 <sup>th</sup> element on the periodic table and...   | <input type="checkbox"/> | a. are removed to increase the iron content.                                      |
| 2. Those who could shape iron into weapons, tools, or other objects... | <input type="checkbox"/> | b. has countless applications in construction, transportation, and manufacturing. |
| 3. Iron is used to produce steel, which...                             | <input type="checkbox"/> | c. forms almost the entire core of the Earth.                                     |
| 4. In humans, iron is crucial...                                       | <input type="checkbox"/> | d. small amounts of titanium, aluminum, or silica may be present.                 |
| 5. Each year, more than 500 million tonnes of new iron...              | <input type="checkbox"/> | e. silicon, aluminum, or manganese.   |
| 6. Hematite is mostly iron and oxygen, but...                          | <input type="checkbox"/> | f. reacts with impurities to form slag.   |
| 7. Limonite often contains...  | <input type="checkbox"/> | g. gained economic and political power.   |
| 8. During reduction in a blast furnace, limestone...                   | <input type="checkbox"/> | h. is tapped from the bottom of the furnace.                                      |
| 9. The molten iron, also called pig iron, ...                          | <input type="checkbox"/> | i. and 300 million tonnes of recycled iron are produced worldwide.                |
| 10. Impurities like silica, clay, and sand...                          | <input type="checkbox"/> | j. for blood and the vascular system.   |

**2** Complete the diagram with the missing words.



**AN INTERESTING FACT ABOUT THE BLAST FURNACE**

A blast furnace can operate continuously for several years without being turned off. Once started, it must stay extremely hot (around 1,500°C), because cooling it down could damage the internal structure and lining. Modern blast furnaces can produce thousands of tons of iron per day.