

Iron (Fe)

Iron ties atomic structure to magnetism, changing crystal structures, rust, ores and steel. It is the ideal stress test for a page where one "solid" phase is not enough to tell the story.

26	Fe	55.845
Atomic number	Iron	Relative atomic mass

1. Quick facts

Property	Value	Meaning for a student
Atomic number	26	26 protons
Electrons	26	neutral Fe atom
Electron configuration	[Ar] 3d ⁶ 4s ²	transition-metal configuration
Relative atomic mass	55.845	natural isotope-weighted value
Key isotope	⁵⁶ Fe	26 protons / 30 neutrons
Group / period	8 / 4	d-block transition metal

2. Atomic structure and electron configuration

Atomic feature	Value	How to read it
Protons	26	Atomic number fixes the proton count.
Electron configuration	[Ar] 3d ⁶ 4s ²	Ground-state orbital bookkeeping.
Shell arrangement	2, 8, 14, 2	Compact shell-count view.
Common oxidation states	+2 and +3 common	Formal oxidation-state bookkeeping, not permanent atom charges.

3. Signature idea

Iron changes magnetism before it changes crystal structure

At ordinary pressure, α -Fe is BCC at room temperature. Around 1043 K it loses long-range ferromagnetic order but remains BCC; at about 1185 K it becomes FCC γ -Fe, then returns to BCC δ -Fe near 1667 K before melting at 1811 K.

Temperature	State / structure	Teaching rule
~298 K	alpha-Fe, BCC, ferromagnetic	Keep magnetic and structural transitions separate.
1043 K	Curie transition: BCC remains, ferromagnetic order is lost	Keep magnetic and structural transitions separate.
1185 K	alpha -> gamma structural transition, BCC -> FCC	Keep magnetic and structural transitions separate.
1667 K	gamma -> delta structural transition, FCC -> BCC	Keep magnetic and structural transitions separate.
1811 K	melting	Keep magnetic and structural transitions separate.

4. Properties, phase behavior and evidence

Property	Value	Meaning for a student
Atomic radius	2.04 Å	RSC non-bonded radius.
Covalent radius	1.24 Å	RSC reference.
Electron affinity	14.569 kJ/mol	Relatively small compared with many nonmetals.
Electronegativity	1.83	Pauling scale.

Evidence context

Atomic values are evaluated reference data. Transition temperatures are recommended atmospheric-pressure values; the Earth markers are 2025 estimated usable iron-ore production, not elemental abundance.

5. Where on Earth?

Iron ore production is not the same as "where iron exists"

Iron is geologically widespread, but modern iron-ore production is an economic layer. The markers use USGS 2025 estimated usable-ore output, labeled by year.

Country	2025 estimate	What the map means
Australia	980 Mt	2025 source-year production layer
Brazil	420 Mt	2025 source-year production layer
India	310 Mt	2025 source-year production layer
China	290 Mt	2025 source-year production layer
Iran	93 Mt	2025 source-year production layer

6. Representative compounds / forms

Hematite / Fe_2O_3 A major iron ore mineral and a familiar Fe(III) oxide.	Magnetite / Fe_3O_4 A mixed-valence iron oxide with important magnetic behavior.
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7. Isotope snapshot

Isotope	Nucleus	Natural abundance / status
^{54}Fe	26 p / 28 n	5.845% - Stable
^{56}Fe	26 p / 30 n	91.754% - Stable
^{57}Fe	26 p / 31 n	2.119% - Stable
^{58}Fe	26 p / 32 n	0.282% - Stable

8. Questions to ask next

Why is iron magnetic? At room temperature α -iron is ferromagnetic because electronic magnetic moments can order collectively in the solid.

Why does iron change crystal structure before it melts? At ordinary pressure the lowest-free-energy solid structure changes with temperature: BCC α -Fe $\rightarrow$ FCC γ -Fe $\rightarrow$ BCC δ -Fe.

Sources

Royal Society of Chemistry - Iron element data

NIST - Iron atomic data

NIST/JPCRD - thermodynamic properties and $\alpha \rightarrow \gamma \rightarrow \delta$ transitions of iron

USGS Mineral Commodity Summaries 2026 - Iron Ore

Full interactive guide: <https://elementlookup.com/iron/>