

Ytterbium (Yb) - Student Datasheet

Element 70 · Lanthanide · source-reviewed learning reference

Ytterbium is element 70, a lanthanide with a filled 4f shell whose Yb²⁺/Yb³⁺ chemistry and narrow optical transitions connect the periodic table to fiber lasers, precision clocks and specialized catalysts.

Quick reference

Atomic number	70
Relative atomic mass	173.045
Electron configuration	[Xe] 4f ¹⁴ 6s ²
Period / group / block	6 / Lanthanide / f
State context	Soft silvery lanthanide metal
Density	6.90 g/cm ³
Melting / transition	1097 K
Boiling / gas reference	1469 K
Oxidation states	+3, +2
Electronegativity	1.10

Structure & orbitals

Ytterbium is represented by its ordinary room-temperature FCC metal structure. Yb-doped laser hosts and optical-clock atoms/ions are separate physical contexts.

The displayed 4f_xyz orbital is one representative real f cubic harmonic. It is not a picture of the whole 4f subshell or the electronic bands in the bulk material.

Phase behavior

At approximately standard pressure, ytterbium is treated as a solid below 1097 K, liquid between melting and approximately 1469 K, and gas above the boiling reference. The ordinary crystal label applies to the stated material reference; unmodeled solid allotropy is not fabricated.

Five things to remember

- Atomic number 70 means every ytterbium nucleus has 70 protons.
- Neutral Ytterbium has the ground-state configuration [Xe] 4f¹⁴ 6s².
- The representative teaching isotope is ¹⁷⁴Yb.
- Ytterbium metal, Yb-doped laser glass and trapped/neutral ytterbium used in precision clocks are different physical systems.
- The ordinary material reference is Face-centred cubic (FCC) at room temperature.

Ytterbium: Real World & Signature Science

Element-specific science, uses and history

Big idea

Ytterbium metal, Yb-doped laser glass and trapped/neutral ytterbium used in precision clocks are different physical systems. The filled $4f^{14}$ neutral-atom configuration does not mean every Yb compound is chemically inert.

Why this element is scientifically distinctive

Explore Yb across the teaching nucleus, isolated-atom orbitals, evidence-aware material structure and temperature/evidence views, then connect those models to uses, isotopes, search-led questions and source-backed context.

Fiber lasers	Yb ³⁺ -doped fibers are widely used in high-power solid-state/fiber laser systems.
Precision clocks	Ytterbium atoms or ions are used in leading optical-frequency clock research because of narrow, controllable transitions.
Catalysis	Yb compounds are used as Lewis-acid catalysts and in specialized synthetic chemistry.
Materials research	Yb appears in intermetallics and correlated-electron materials where valence can be unusual.
Compound boundary	Yb-doped fibers and clock-trapped atoms are not bulk FCC ytterbium metal; each system has its own physical model.

From source material to Ytterbium applications: high-level material path

1. Ytterbium is obtained from mineral or metallurgical feedstocks in which it is chemically associated with other elements rather than mined as abundant native metal.
2. Industrial separation and refining produce element-specific compounds or metal feedstock; this guide does not provide operational extraction recipes.
3. The refined material is converted into the particular alloy, compound, doped host or component required by the application.
4. Recycling and recovery depend on the host product, concentration and economics; application materials must not be confused with pure element.

History checkpoints

1878	Jean Charles Galissard de Marignac separated ytterbium from erbium-rich material in Geneva.
1907	Further work showed the earlier ytterbium fraction contained another element, later named lutetium.
20th century	Purification and spectroscopy revealed useful Yb ²⁺ /Yb ³⁺ optical and solid-state behavior.
Today	Yb is important in fiber lasers, precision metrology and advanced materials research.

Use contexts

- ['Fiber lasers', 'Yb³⁺-doped fibers and crystals support efficient high-power laser systems.']
- ['Optical clocks', 'Neutral Yb or Yb ions support precision frequency-standard research.']
- ['Catalysis', 'Ytterbium compounds are used in specialized Lewis-acid and synthetic chemistry.']
- ['Advanced materials', 'Yb intermetallics are studied for unusual valence and correlated-electron behavior.']

Ytterbium: Isotopes, Questions & Evidence

Evidence status and learner self-check

Isotope context

¹⁷⁴Yb	Most abundant natural isotope	Reference teaching isotope for this page.
Natural ytterbium	Multiple-isotope element	Several naturally occurring isotopes contribute to the atomic weight.
Clock isotopes	Isotope-specific precision physics	Selected Yb isotopes are used in atomic/ion clock research.

Common questions

What is ytterbium?

Ytterbium is chemical element 70, symbol Yb, a soft silvery lanthanide metal.

What is ytterbium used for?

Important uses include Yb-doped fiber lasers, precision atomic clocks, catalysts and advanced materials research.

Where is ytterbium found?

It occurs mixed with other lanthanides in minerals such as monazite and is separated during rare-earth processing.

Who discovered ytterbium?

Jean Charles Galissard de Marignac separated ytterbium in 1878.

How do you pronounce ytterbium?

A common pronunciation is ih-TER-bee-um.

Is ytterbium a metal?

Yes. It is a lanthanide metal.

Evidence & safety

Atomic identity and reference values are source-reviewed. Material viewers are teaching representations, not crystallographic refinements. Search demand shapes headings and FAQs but never overrides measured/evaluated evidence or element-versus-compound distinctions.

This page is educational. Chemical, occupational, radiological or medical safety decisions require the specific material/isotope, its current safety data and qualified guidance.

Core sources

Royal Society of Chemistry - Ytterbium - <https://periodic-table.rsc.org/element/70/ytterbium>

NIST - Atomic Weights and Isotopic Compositions - https://physics.nist.gov/cgi-bin/Compositions/stand_alone.pl

IUPAC - Periodic Table of Elements - <https://iupac.org/what-we-do/periodic-table-of-elements/>