

Neodymium (Nd) - Student Datasheet

Element 60 · Lanthanide · source-reviewed learning reference

Neodymium is element 60, a lanthanide whose Nd^{3+} chemistry, 4f electrons and distinctive metal phases connect atomic structure to Nd-Fe-B permanent magnets, Nd:YAG lasers and rare-earth materials.

Quick reference

Atomic number	60
Relative atomic mass	144.242
Electron configuration	[Xe] 4f ⁴ 6s ²
Period / group / block	6 / Lanthanide / f
State context	Silvery lanthanide metal
Density	7.01 g/cm ³
Melting / transition	1289 K
Boiling / gas reference	3347 K
Oxidation states	+3
Electronegativity	1.14

Structure & orbitals

Neodymium metal is double-hexagonal close-packed near room temperature and transforms to BCC at high temperature. The viewer shows a DHCP teaching model; the phase track carries the solid-solid transition.

The 4f_xyz, 6s visuals are isolated-atom probability teaching models. They do not depict electron bands, bonding orbitals or the crystal electronic structure of Neodymium materials.

Phase behavior

At approximately standard pressure, neodymium is DHCP at lower temperatures, transforms to BCC near 1133 K, melts at 1289 K, and boils near 3347 K.

Five things to remember

- Atomic number 60 means 60 protons.
- Neutral Neodymium has [Xe] 4f⁴ 6s².
- Its representative teaching isotope is ¹⁴²Nd.
- A “neodymium magnet” is not pure neodymium.
- The ordinary material reference is double hexagonal close-packed near room temperature.

Neodymium: Real World & Signature Science

Element-specific science, uses and history

Big idea

A “neodymium magnet” is not pure neodymium. The strongest common permanent magnets are engineered Nd-Fe-B materials, especially the $\text{Nd}_2\text{Fe}_{14}\text{B}$ phase. Their strong magnetism comes from the ordered compound/microstructure, not from a lump of elemental Nd alone.

Why this element is scientifically distinctive

Explore Nd 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.

Permanent magnets	Nd-Fe-B magnets are engineered intermetallic/material systems containing neodymium, iron and boron.
Lasers	Nd:YAG uses Nd^{3+} ions doped into a yttrium aluminium garnet host crystal.
Glass color	Neodymium compounds can color glass and filter characteristic wavelengths.
Rare-earth supply	Neodymium is separated from mixed rare-earth ores and commonly enters magnet supply chains.
Isotopes	Natural neodymium contains several stable and very long-lived isotopes.

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

1. Mixed rare-earth minerals enter beneficiation and chemical separation.
2. Closely related lanthanides are separated to produce neodymium-rich compounds or metal/alloy feedstocks.
3. Magnet manufacturing combines neodymium with iron and boron into engineered magnetic phases; laser routes use Nd^{3+} dopants in host crystals.
4. Magnet recycling and rare-earth recovery can return neodymium to the material cycle.

History checkpoints

1885	Carl Auer von Welsbach separated didymium into neodymium and praseodymium.
Late 19th century	Spectroscopy confirmed distinct rare-earth identities.
1960s	Nd-doped laser materials became important solid-state laser media.
1980s	Nd-Fe-B permanent magnets transformed compact motor, audio and electronics design.

Neodymium: Isotopes, Questions & Evidence

Evidence status and learner self-check

Isotope context

¹⁴² Nd	Stable natural isotope	Most abundant natural neodymium isotope.
¹⁴⁴ Nd	Very long-lived alpha emitter	Natural isotope whose half-life is enormous.
¹⁵⁰ Nd	Very long-lived double-beta emitter	Natural isotope studied in nuclear physics.

Common questions

What is neodymium?

Neodymium is chemical element 60, a lanthanide metal.

What is a neodymium magnet?

It is an engineered Nd-Fe-B magnetic material, not pure elemental neodymium.

What is neodymium used for?

Major uses include Nd-Fe-B magnets, Nd-doped lasers and specialty glass.

Is neodymium magnetic?

Elemental neodymium has magnetic behavior, but the exceptionally strong permanent magnets are Nd-Fe-B materials with ordered magnetic phases.

Quick self-check

Q: What is Neodymium's atomic number? | Answer: 60. Atomic number equals proton count.

Q: Which classification best fits Neodymium? | Answer: Lanthanide. Periodic position and chemistry define the classification.

Q: What is the representative teaching isotope? | Answer: ¹⁴²Nd. An isotope mass number is not the same thing as relative atomic mass.

Evidence & safety

Atomic identity, reference values and ordinary structures are source-reviewed. Material viewers are teaching representations, not crystallographic refinements. Search demand never overrides measured/evaluated evidence or compound-vs-element distinctions.

Neodymium metal, powders, Nd-Fe-B magnets and soluble compounds have different hazards. Strong magnets also create pinch/projectile and device-interference risks beyond chemistry.

Core sources

Royal Society of Chemistry - Neodymium

<https://periodic-table.rsc.org/element/60/neodymium>

NIST - Atomic Weights and Isotopic Compositions

https://physics.nist.gov/cgi-bin/Compositions/stand_alone.pl

USGS - Mineral Commodity Summaries 2026

<https://pubs.usgs.gov/publication/mcs2026>