

Gadolinium (Gd) - Student Datasheet

Element 64 · Lanthanide · source-reviewed learning reference

Gadolinium is element 64, a lanthanide with seven 4f electrons, strong magnetic behavior and exceptional neutron-capture isotopes. Its chemistry also underpins gadolinium-based MRI contrast agents—but those chelated compounds are not elemental Gd metal.

Quick reference

Atomic number	64
Relative atomic mass	157.25
Electron configuration	[Xe] 4f ⁷ 5d ¹ 6s ²
Period / group / block	6 / Lanthanide / f
State context	Silvery lanthanide metal
Density	7.90 g/cm ³
Melting / transition	1586 K
Boiling / gas reference	3546 K
Oxidation states	+3
Electronegativity	1.20

Structure & orbitals

Gadolinium metal is HCP near room temperature and transforms to BCC at high temperature shortly before melting. The viewer shows the ordinary HCP lattice; the phase track carries the high-temperature transition.

The 4f_xyz, 5d_z2, 6s visuals are isolated-atom probability teaching models. They do not depict electron bands, bonding orbitals or the crystal electronic structure of Gadolinium materials.

Phase behavior

At approximately standard pressure, gadolinium is HCP through most of its solid range, changes to BCC near 1534 K, melts near 1586 K, and boils near 3546 K.

Five things to remember

- Atomic number 64 means 64 protons.
- Neutral Gadolinium has [Xe] 4f⁷ 5d¹ 6s².
- Its representative teaching isotope is ¹⁵⁸Gd.
- Elemental gadolinium, gadolinium compounds and gadolinium-based contrast agents (GBCAs) must be kept separate.
- The ordinary material reference is hcp near room temperature; bcc at high temperature.

Gadolinium: Real World & Signature Science

Element-specific science, uses and history

Big idea

Elemental gadolinium, gadolinium compounds and gadolinium-based contrast agents (GBCAs) must be kept separate. GBCAs are chelated gadolinium compounds used in MRI and are distinct from iodinated X-ray/CT contrast agents. Medical safety depends on the specific agent and patient factors.

Why this element is scientifically distinctive

Explore Gd 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.

Magnetism	Gadolinium's half-filled 4f shell gives strong magnetic moments and a magnetic ordering transition near room temperature.
MRI contrast chemistry	Clinical GBCAs are chelated gadolinium compounds, not elemental gadolinium metal and not iodinated contrast.
Neutron capture	¹⁵⁵ Gd and especially ¹⁵⁷ Gd have very large thermal-neutron capture cross sections.
Phosphors & materials	Gd compounds appear in phosphors, scintillators, magnetic refrigeration research and specialized ceramics.
Medical safety boundary	GBCA retention and kidney-related risks are regulated medical topics; individual decisions belong to clinicians.

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

1. Gadolinium is separated from mixed rare-earth mineral concentrates through industrial rare-earth refining.
2. Purified compounds feed magnetic, neutron, scintillator and medical-contrast manufacturing chains.
3. MRI contrast products use strongly chelated gadolinium compounds under pharmaceutical quality systems; they are not elemental-metal formulations.
4. Recycling/recovery opportunities vary by material system; no pharmaceutical or chemical preparation instructions are provided.

History checkpoints

1880	Jean Charles Galissard de Marignac observed spectral evidence for a new rare-earth component.
1886	Paul-Émile Lecoq de Boisbaudran isolated gadolinium oxide more clearly and the element became established.
Naming	Gadolinium was named after Johan Gadolin, a pioneer of rare-earth chemistry.
Modern era	Gd compounds became important in magnetic, neutron, optical and MRI-contrast technologies.

Gadolinium: Isotopes, Questions & Evidence

Evidence status and learner self-check

Isotope context

¹⁵⁸ Gd	Stable natural isotope	Most abundant natural gadolinium isotope.
¹⁵⁷ Gd	Stable natural isotope	Notable for an exceptionally large thermal-neutron capture cross section.
¹⁵² Gd	Very long-lived natural isotope	Radioactive only on immense timescales.

Common questions

What is gadolinium?

Gadolinium is chemical element 64, a lanthanide metal.

Is gadolinium a metal?

Yes. Elemental gadolinium is a silvery lanthanide metal.

What is gadolinium used for?

Gadolinium compounds are used in MRI contrast agents, neutron-absorbing materials, scintillators and magnetic-material research.

Does gadolinium contain iodine?

No. Gadolinium is element 64. Gadolinium-based MRI contrast agents are chemically distinct from iodinated X-ray/CT contrast agents.

Quick self-check

Q: What is Gadolinium's atomic number? | Answer: 64. Atomic number equals proton count.

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

Q: What is the representative teaching isotope? | Answer: ¹⁵⁸Gd. 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.

Elemental gadolinium is not an MRI contrast injection. Questions about GBCA choice, kidney function, pregnancy, prior reactions, retention or individual medical risk require a qualified clinician and the product-specific prescribing information.

Core sources

Royal Society of Chemistry - Gadolinium

<https://periodic-table.rsc.org/element/64/gadolinium>

FDA - Gadolinium-based contrast agent safety communications

<https://www.fda.gov/drugs/drug-safety-and-availability/fda-drug-safety-communication-fda-warns-gadolinium-based-contrast-agents-gbcas-are-retained-body>

NIST - Atomic Weights and Isotopic Compositions

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