

Cadmium (Cd) - Student Datasheet

Element 48 · Transition/post-transition Group 12 metal · source-reviewed learning reference

Cadmium is element 48, a soft Group 12 metal with a filled 4d shell, HCP crystal and low melting point. Its battery, pigment and semiconductor history is inseparable from an important toxicity and environmental-safety boundary.

Quick reference

Atomic number	48
Relative atomic mass	112.414
Electron configuration	[Kr] 4d ¹⁰ 5s ²
Period / group / block	5 / 12 / d
State context	Soft bluish-white toxic metal
Density	8.69 g/cm ³
Melting / transition	594.219 K
Boiling / gas reference	1040 K
Oxidation states	+2
Electronegativity	1.69

Structure & orbitals

Ordinary cadmium metal is HCP. The viewer shows the elemental metal lattice and does not represent CdS, CdO, CdCl₂ or CdTe compound structures.

The 4d_{z²}, 5s visuals are isolated-atom probability teaching models. They do not depict electron bands, bonding orbitals or the crystal electronic structure of Cadmium materials.

Phase behavior

At approximately standard pressure, cadmium is HCP solid below 594.219 K, liquid to about 1040 K, and gaseous above the boiling reference.

Five things to remember

- Atomic number 48 means 48 protons.
- Neutral Cadmium has [Kr] 4d¹⁰ 5s².
- Its representative teaching isotope is ¹¹⁴Cd.
- Cadmium metal, cadmium sulfide, cadmium oxide, cadmium chloride and cadmium telluride are different substances.
- The ordinary material reference is hexagonal close-packed.

Cadmium: Real World & Signature Science

Element-specific science, uses and history

Big idea

Cadmium metal, cadmium sulfide (CdS), cadmium oxide (CdO), cadmium chloride (CdCl₂) and cadmium telluride (CdTe) are different substances. Search interest often mixes them, so this page names the chemical form explicitly before discussing a use, property or hazard.

Why this element is scientifically distinctive

Explore Cd 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.

Rechargeable batteries	Nickel-cadmium batteries use cadmium-containing electrode material; the technology is regulated or restricted in many contexts.
Solar cells	Cadmium telluride (CdTe) is a distinct semiconductor compound used in thin-film photovoltaics; it is not elemental cadmium.
Pigments & CdS	Cadmium sulfide (CdS) and CdS/CdSe materials produced vivid historical pigments and are semiconductors; use is constrained by cadmium toxicity.
Cadmium oxide	CdO is a cadmium-oxygen compound used in selected electronic, electrode and materials contexts; its properties are not those of Cd metal.
Cadmium chloride	CdCl ₂ is an ionic cadmium chloride compound used as a chemical/material precursor in controlled settings; it is not another name for the element.
Health boundary	Cadmium exposure is hazardous; this page does not provide detoxification, treatment or exposure-management advice.

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

1. Cadmium is commonly recovered as a by-product of zinc and other nonferrous-metal processing.
2. Refining produces cadmium metal or compounds under regulated industrial controls.
3. Materials enter batteries, coatings or compound semiconductor/pigment supply chains where permitted.
4. Hazardous-material regulations and recycling requirements are integral to the cadmium life cycle.

History checkpoints

1817	Friedrich Stromeyer discovered cadmium while investigating zinc compounds.
19th century	Cadmium pigments and metal uses expanded as separation techniques improved.
20th century	Ni-Cd batteries and specialized plating became important applications.
Modern era	Environmental and occupational controls increasingly restrict cadmium uses and emissions.

Use contexts

- ['Ni-Cd batteries', 'Nickel-cadmium batteries use cadmium-containing active materials; collection and disposal are regulated in many jurisdictions.']
- ['CdTe photovoltaics', 'Cadmium telluride is a semiconductor compound used in thin-film solar modules.']
- ['CdS pigments/optoelectronics', 'Cadmium sulfide has historical pigment uses and semiconductor/optoelectronic applications.']
- ['CdO and other compounds', 'Cadmium oxide and other cadmium compounds have specialized electrical/material roles.']

Cadmium: Isotopes, Questions & Evidence

Evidence status and learner self-check

Isotope context

¹¹⁴Cd	Stable natural isotope	A common natural cadmium isotope used as the teaching nucleus.
¹¹³Cd	Very long-lived radioactive natural isotope	Also notable for strong neutron absorption.
Natural cadmium	Multiple-isotope mixture	Includes stable and very long-lived radioactive isotopes.

Common questions

What is cadmium?

Cadmium is chemical element 48, symbol Cd, a soft Group 12 metal.

Is cadmium toxic?

Yes. Cadmium exposure is hazardous, especially in occupational and environmental contexts; this page does not provide treatment advice.

What is cadmium used for?

Uses include nickel-cadmium batteries, specialized coatings and cadmium compounds in pigments, electronic materials and CdTe solar cells.

Is cadmium a metal?

Yes. It is a soft bluish-white to silvery metal.

What is cadmium sulfide?

Cadmium sulfide (CdS) is a cadmium-sulfur semiconductor compound historically used in pigments and optoelectronic contexts; it is not elemental cadmium.

What is cadmium oxide?

Cadmium oxide (CdO) is a cadmium-oxygen compound with electronic and materials uses; it has a different structure and properties from Cd metal.

What is cadmium chloride?

Cadmium chloride (CdCl₂) is an ionic cadmium compound and chemical/material precursor; it is not elemental Cd.

What is the charge of cadmium?

A neutral Cd atom has no net charge. Cadmium most commonly forms the Cd²⁺ ion in compounds.

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.

Cadmium is toxic. Do not use this educational page for exposure treatment, “detox,” handling, disposal or medical decisions. Follow applicable occupational/environmental rules and qualified professional guidance.

Core sources

Royal Society of Chemistry - Cadmium - <https://periodic-table.rsc.org/element/48/cadmium>

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

WHO - Cadmium health context - <https://www.who.int/news-room/fact-sheets/detail/cadmium>