

# Chromium (Cr) - Student Datasheet

Atomic number 24 - Transition metal - Group 6 - Period 4 - d-block

Chromium is element 24, a hard transition metal central to stainless steel and corrosion resistance. Its chemistry also teaches an essential safety distinction: metallic chromium, Cr(III) compounds and Cr(VI) compounds are not interchangeable.

## Quick reference

|                        |                                      |
|------------------------|--------------------------------------|
| Atomic number          | 24                                   |
| Relative atomic mass   | 51.9961                              |
| Electron configuration | [Ar] 3d <sup>5</sup> 4s <sup>1</sup> |
| State at 20 C          | Hard silvery metal at 20 deg C       |
| Density                | 7.15 g/cm <sup>3</sup>               |
| Melting point          | 2180 K                               |
| Boiling point          | 2944 K                               |
| Common oxidation state | +2, +3, +6 (among several states)    |
| Electronegativity      | 1.66                                 |

## Structure & orbitals

Chromium is body-centred cubic near room temperature. The viewer is a conventional BCC cell; chromium compounds have entirely different structures.

Atomic 3d/4s probability models explain electron occupancy, not the exact electronic band structure of chromium metal or the ligand-field states of chromium compounds.

## Temperature / phase context

At approximately standard pressure, chromium remains BCC solid up to its melting region near 2180 K, then liquid to the boiling reference near 2944 K. This track does not attempt magnetic-order transitions or high-pressure polymorphs.

## Five things to remember

- Atomic number 24 means 24 protons.
- Chromium's ground state is [Ar] 3d<sup>5</sup>4s<sup>1</sup>, an important electron-configuration exception.
- Metallic chromium is BCC at ordinary conditions.
- Chromium is essential to stainless steel and many corrosion-resistant alloys.
- Cr(VI) compounds present serious health hazards; they must not be treated as equivalent to elemental Cr or Cr(III).

# Chromium: Real World & Signature Science

"Chromium" is not one toxicological category. Oxidation state and chemical form matter enormously. Element Lookup separates Cr metal, Cr(III) and Cr(VI) rather than transferring properties from one form to another.

## Why this element matters

|                                                                                                                                             |                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Stainless steel</b><br>Chromium additions create corrosion-resistant stainless steels by enabling a protective chromium-rich oxide film. | <b>Chrome &amp; coatings</b><br>Chromium-containing coatings and surface treatments can provide wear/corrosion performance, subject to chemistry and regulatory controls. |
| <b>Pigments &amp; compounds</b><br>Chromium compounds span many colors and oxidation states; properties depend on the specific species.     | <b>Chromite supply</b><br>Chromium is obtained mainly from chromite ore and commonly enters steelmaking through ferrochromium.                                            |
| <b>Recycling</b><br>Stainless-steel scrap is an important secondary source of chromium.                                                     |                                                                                                                                                                           |

## From chromite ore to chromium-bearing materials: a high-level path

1. Chromite ore is mined and concentrated in several countries; mine geography is distinct from ferrochrome and stainless-steel production.
2. Smelting converts suitable feed into ferrochromium for alloy production; operational furnace recipes are outside this educational page.
3. Stainless-steel and superalloy producers add chromium through ferroalloys, metal and recycled scrap.
4. Chromium chemicals follow separate conversion routes and require oxidation-state-specific handling and environmental controls.

## Where on Earth?

### Chromite supply

South Africa, Kazakhstan and Turkiye illustrate major chromite/ferrochrome supply context; mine and steel geography are distinct.

## History

**1797** - Louis Nicolas Vauquelin identified chromium in crocoite and later isolated the metal.

**19th century** - Chromium pigments and plating became important industrial applications.

**20th century** - Stainless steel made chromium a core alloying element for corrosion-resistant infrastructure and products.

**Today** - Chromium supply, stainless-steel recycling and control of hazardous Cr(VI) compounds are all important but distinct topics.

## Uses

|                                                                                                                                                     |                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <b>Stainless &amp; heat-resistant steels</b><br>Chromium is a defining alloying element in stainless steel and many high-temperature alloys.        | <b>Surface engineering</b><br>Chromium-containing coatings/treatments are used for corrosion, appearance and wear performance. |
| <b>Chemical compounds</b><br>Cr(III) and other chromium compounds are used in pigments, catalysts and specialty chemistry; specific species matter. | <b>Recycling</b><br>Chromium in stainless-steel scrap can return to alloy production, reducing demand for primary units.       |

# Chromium: Isotopes, Questions & Evidence

## Isotopes

**<sup>52</sup>Cr** - Stable - dominant natural isotope

Reference teaching nucleus: 24 protons and 28 neutrons.

**<sup>53</sup>Cr** - Stable natural isotope

Used in isotope-geochemistry applications including extinct-radionuclide systems.

**<sup>50</sup>Cr and <sup>54</sup>Cr** - Stable natural isotopes

Minor components of natural chromium.

## Common questions

**What is chromium's atomic number?**

24.

**Is chromium a metal?**

Yes. Chromium is a transition metal.

**What is chromium used for?**

Its largest role is in stainless and alloy steels; it is also used in surface engineering and chemical compounds.

**Why is chromium's electron configuration unusual?**

The ground state is [Ar] 3d<sup>5</sup>4s<sup>1</sup> rather than a simple 3d<sup>4</sup>4s<sup>2</sup> pattern, reflecting the energetic balance of d and s subshells.

**Is all chromium toxic in the same way?**

No. Chemical form and oxidation state matter. Cr(VI) compounds are a major health hazard and should not be equated with metallic chromium or Cr(III).

**What ore supplies chromium?**

Chromite is the principal chromium ore mineral.

## Quick self-check

1. Atomic number? Answer: 24
2. Ground-state configuration ending? Answer: 3d<sup>5</sup> 4s<sup>1</sup>
3. Room-temperature lattice? Answer: BCC
4. Principal ore? Answer: Chromite
5. Which statement is scientifically correct? Answer: Cr(VI), Cr(III) and Cr metal have different chemical/toxicological behavior

## Safety boundary

**Hexavalent chromium compounds are serious occupational/environmental hazards. This page distinguishes oxidation states and does not provide recipes for producing or using hazardous Cr(VI) compounds.**

## Evidence & provenance

Atomic and bulk-metal values are evaluated. Chemistry and safety statements distinguish species explicitly. Commodity geography uses dated chromite/ferrochrome context and does not imply that all chromium use occurs at mine locations.

## Core sources

|                                         |                                                                                                                                                               |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Royal Society of Chemistry - Chromium   | <a href="https://periodic-table.rsc.org/element/24/chromium">https://periodic-table.rsc.org/element/24/chromium</a>                                           |
| NIST - Atomic Data for Chromium         | <a href="https://physics.nist.gov/PhysRefData/Handbook/Tables/chromiumtable1.htm">https://physics.nist.gov/PhysRefData/Handbook/Tables/chromiumtable1.htm</a> |
| USGS - Mineral Commodity Summaries 2026 | <a href="https://pubs.usgs.gov/publication/mcs2026">https://pubs.usgs.gov/publication/mcs2026</a>                                                             |