

Molybdenum (Mo) - Student Datasheet

Element 42 · Transition metal · source-reviewed learning reference

Molybdenum is element 42, a refractory Group 6 metal with a high melting point and rich oxidation chemistry. It strengthens high-temperature alloys, forms layered MoS₂ lubricants and appears in biological molybdenum cofactors.

Quick reference

Atomic number	42
Relative atomic mass	95.95
Electron configuration	[Kr] 4d ⁵ 5s ¹
Period / group / block	5 / 6 / d
State context	Hard silvery refractory metal · solid at 20 °C
Density	10.2 g/cm ³
Melting / transition	2895 K
Boiling / gas reference	4912 K
Oxidation states	+6, +5, +4, +3, +2
Electronegativity	2.16

Structure & orbitals

Pure molybdenum metal is BCC near room temperature. The conventional-cell viewer is separate from layered MoS₂, molybdate compounds and biological molybdenum cofactors.

The 4d and 5s probability clouds are isolated-atom teaching models. d labels are explicit representative angular forms; they are not literal metallic-band or MoS₂ electron-density maps.

Phase behavior

At approximately standard pressure, molybdenum remains BCC solid to about 2895 K, liquid to about 4912 K, and gaseous above the boiling reference.

Five things to remember

- Atomic number 42 means 42 protons.
- The reference ground-state configuration is [Kr] 4d⁵ 5s¹.
- Molybdenum metal is BCC and melts near 2895 K.
- MoS₂ is a layered compound used as a lubricant and 2D-material platform; it is not metallic Mo.
- Molybdenum also participates in important enzyme cofactors.

Molybdenum: Real World & Signature Science

Element-specific science, uses and history

Big idea

Molybdenum metal, molybdenum disulfide and molybdate chemistry are not interchangeable. One element can participate in very different bonding networks, material properties and biological roles.

Why this element is scientifically distinctive

Rotate a ^{98}Mo nucleus and BCC metal cell, inspect 4d/5s probability models, then compare refractory metal, layered MoS_2 and catalytic/biological molybdenum chemistry.

High-strength alloys	Molybdenum improves strength, hardenability and high-temperature performance in steels and superalloys.
MoS_2	Molybdenum disulfide has a layered structure used in solid lubrication and studied as a two-dimensional semiconductor.
Catalysts	Molybdenum compounds are important in industrial catalytic systems, including petroleum-processing contexts.
Biological cofactors	Molybdenum is an essential trace element in enzymes that carry out key redox reactions.
Commodity geography	Most molybdenum comes from molybdenite ores and as a co-product/by-product of porphyry copper systems.

From molybdenite to molybdenum products: high-level path

1. Molybdenum is commonly mined from molybdenite-bearing deposits or recovered as a co-product of copper mining.
2. Concentrates are processed into molybdenum chemical intermediates.
3. Industrial refining produces molybdenum metal, ferroalloys or compounds under controlled high-temperature/chemical processes; recipes are outside this guide.
4. Recycling of alloy scrap and catalysts contributes secondary molybdenum supply.

History checkpoints

1778	Carl Wilhelm Scheele distinguished molybdena from graphite/lead ores.
1781	Peter Jacob Hjelm isolated molybdenum metal.
20th century	Molybdenum became strategically important in high-strength steels and high-temperature alloys.
Today	Uses span alloying, catalysis, lubricants, electronics research and biological chemistry.

Molybdenum: Isotopes, Questions & Evidence

Evidence status and learner self-check

Isotope context

⁹⁸ Mo	Stable natural isotope	Reference teaching nucleus with 42 protons and 56 neutrons.
⁹⁵ Mo	Stable natural isotope	One of several stable natural molybdenum isotopes.
¹⁰⁰ Mo	Very long-lived double-beta-decay isotope	Important in rare-event nuclear-physics research.

Common questions

What is molybdenum?

Molybdenum is element 42, a refractory transition metal.

What is molybdenum used for?

Major uses include alloy steels, high-temperature materials, catalysts and MoS₂ lubricants/materials.

Where is molybdenum found?

Commonly in molybdenite-bearing deposits and as a co-product of porphyry copper mining.

Is molybdenum a metal?

Yes, it is a Group 6 transition metal.

Quick self-check

Q: What is molybdenum's atomic number? | Answer: 42. Atomic number equals proton count.

Q: What is the ordinary metal structure? | Answer: BCC. Pure Mo is BCC near room temperature.

Q: Which compound is a layered lubricant? | Answer: MoS₂. Molybdenum disulfide is a distinct layered compound.

Evidence & safety

Atomic and ordinary bulk metal values are evaluated. The BCC viewer is a conventional cell. Mine-production points are dated commodity examples; MoS₂ and biological contexts are compounds/cofactors, not alternate "forms" of the metal.

Molybdenum metal, dusts and compounds have different exposure profiles. Engineering or occupational decisions require material-specific data.

Core sources

Royal Society of Chemistry - Molybdenum

<https://periodic-table.rsc.org/element/42/molybdenum>

NIST - Atomic Data for Molybdenum

<https://physics.nist.gov/PhysRefData/Handbook/Tables/molybdenumtable1.htm>

USGS - Mineral Commodity Summaries 2026

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