

Selenium (Se) - Student Datasheet

Element 34 · Chalcogen / nonmetal-metalloid border · source-reviewed learning reference

Selenium is element 34, a Group 16 element whose gray and red allotropes connect bonding, structure and light-sensitive electrical behavior. Most commercial selenium is recovered as a by-product of copper refining rather than from a dedicated selenium mine.

Quick reference

Atomic number	34
Relative atomic mass	78.971
Electron configuration	[Ar] 3d ¹⁰ 4s ² 4p ⁴
Period / group / block	4 / 16 / p
Ordinary state	Solid at 20 °C · gray/red allotropes
Density	4.809 g/cm ³ (gray Se)
Melting point	494 K
Boiling point	958 K
Oxidation states	−2, +4, +6
Electronegativity	2.55

Structure & orbitals

The material view emphasizes the repeating helical-chain motif of stable gray/trigonal selenium. Red allotropes have different molecular/polymeric structures and are handled in Signature Science.

The 4s and 4p probability clouds are hydrogen-like teaching distributions. Selecting p_x/p_y/p_z changes orientation; the plots are not crystalline band structures.

Phase behavior

A bulk teaching path uses gray selenium as the ordinary solid reference, melting near 494 K and boiling near 958 K. Solid-allotrope transformations are complex and are not reduced to a fabricated single transition temperature.

Five things to remember

- Atomic number 34 means 34 protons.
- Neutral selenium has [Ar] 3d¹⁰ 4s² 4p⁴.
- Gray selenium uses helical chains and is the most stable allotrope under ordinary conditions.
- Gray selenium is photoconductive: its electrical response changes with illumination.
- Selenium is an essential trace nutrient in small amounts, but excess exposure can be harmful.

Selenium: Real World & Signature Science

Big idea

Selenium is neither “just a nutrient” nor “just a semiconductor.” Elemental allotropes, selenide/selenite/selenate compounds and biological trace chemistry are distinct contexts with different properties and risks.

Why this element is scientifically distinctive

Compare Se with Se^{2-} , inspect a ^{80}Se teaching nucleus, rotate a gray-selenium helical motif, explore 4p orbitals, then connect allotropy to photoconductivity, glassmaking, copper-refinery recovery and trace-element biology.

Glass	Selenium compounds can decolorize glass or impart red/bronze tones.
Photoconductivity	Gray selenium’s conductivity changes with light, historically important in photocells and imaging technologies.
Copper-refinery by-product	Commercial selenium is commonly recovered from anode slimes generated during electrolytic copper refining.
Biology	Selenium is an essential trace element in humans and other organisms, but the safe range is narrow.
Allotropes	Red and gray selenium have different structures and macroscopic properties even though every atom remains element 34.

From copper-refinery by-product to selenium materials: a high-level path

1. Selenium occurs dispersed in sulfide ores and is rarely produced from a dedicated selenium ore body.
2. During electrolytic copper refining, selenium can concentrate in anode slimes.
3. Industrial recovery converts these by-product streams into selenium and selenium compounds in controlled facilities.
4. Refined selenium then enters glass, pigment, metallurgical, electronic and chemical applications.

History checkpoints

1817	Jöns Jacob Berzelius identified selenium while investigating residues from sulfuric-acid production in Sweden.
19th century	Selenium’s light-sensitive electrical behavior was discovered and became important in early photoelectric technologies.
20th century	Glass, pigments, rectifiers and imaging uses expanded, while copper refining became a major supply route.
Today	Selenium spans materials, metallurgy, glassmaking, electronics and trace-element biology.

Selenium: Isotopes, Questions & Evidence

Isotope context

⁸⁰Se	Stable · most abundant natural isotope	Reference teaching nucleus with 34 protons and 46 neutrons.
⁷⁸Se	Stable natural isotope	One of several stable selenium isotopes.
⁸²Se	Very long-lived double-beta isotope	Important in nuclear/particle-physics research contexts.

Common questions

What is selenium's atomic number?

34.

Is selenium a metal?

It is commonly described as a nonmetal with semiconducting/metalloid-like physical behavior depending on allotrope; simple labels do not capture all of its materials science.

How many valence electrons does selenium have?

Six, from $4s^2 4p^4$.

Why is selenium used in light-sensitive devices?

Gray selenium is photoconductive: illumination changes its electrical conductivity.

Quick self-check

Q: What is selenium's atomic number? | Answer: 34. Atomic number equals proton count.

Q: How many valence electrons does selenium have? | Answer: 6. Its outer pattern is $4s^2 4p^4$.

Q: Which allotrope is the stable ordinary teaching reference? | Answer: Gray trigonal selenium. Gray selenium is the stable ordinary allotrope reference.

Evidence & safety

Atomic and ordinary physical values are evaluated. The gray-selenium helical structure is a teaching motif, not a full coordinate reconstruction. Supply-chain statements emphasize by-product recovery rather than invented "selenium mine" pins.

Selenium is biologically essential in trace amounts but can be toxic in excess. This page is chemistry education, not nutritional or medical advice.

Core sources

Royal Society of Chemistry - Selenium

<https://periodic-table.rsc.org/element/34/selenium>

NIST - Atomic Data for Selenium

<https://physics.nist.gov/PhysRefData/Handbook/Tables/seleniumtable1.htm>

USGS - Selenium statistics and information

<https://www.usgs.gov/centers/national-minerals-information-center/selenium-statistics-and-information>