

Sulfur (S) - Student Datasheet

Atomic number 16 - Nonmetal · chalcogen - Group 16 - Period 3 - p-block

Sulfur is element 16, a yellow Group 16 nonmetal with six valence electrons and an unusually rich allotrope story. At room temperature the familiar form is built from crown-shaped S₈ molecules, while sulfur chemistry links proteins, minerals, fuels, fertilizers and sulfuric acid.

Quick reference

Atomic number	16
Relative atomic mass	32.06
Electron configuration	[Ne] 3s ² 3p ⁴
Common oxidation state(s)	-2, +4, +6 common
Density	2.07 g/cm ³
Melting point	388.36 K · reference value
Boiling point	717.76 K
Structure near room temperature	α-sulfur · S ₈ molecular crystal

Structure & orbitals

Reference isotope: ³²S - 16 protons + 16 neutrons. Ground-state/reference electron configuration: [Ne] 3s² 3p⁴.

The occupied 3s orbital is spherical with two radial nodes in this hydrogen-like teaching approximation. The occupied 3p model has one radial node and a two-lobed angular form; x/y/z controls rotate that same p shape in space. These clouds describe isolated-atom probability distributions, not S₈ bonds or electron trajectories.

Material / molecular structure: Room-temperature α-sulfur is orthorhombic and built from crown-shaped S₈ molecules; the viewer focuses on one S₈ molecular teaching model

Phase / temperature context

Sulfur's ordinary-pressure phase behavior is allotrope-sensitive. This teaching path shows room-temperature α-sulfur, a transition toward β-sulfur near 368 K, a reference melting boundary near 388 K, and boiling near 718 K. Reported melting behavior can differ with allotrope and thermal history, so the labels are deliberately approximate.

Five things to remember

1. Atomic number 16 means every sulfur nucleus contains 16 protons.
2. Neutral sulfur has six valence electrons: [Ne] 3s² 3p⁴.
3. The common room-temperature allotrope contains crown-shaped S₈ molecules in an orthorhombic crystal.
4. Sulfur has several allotropes and temperature-dependent structural behavior; one 'solid sulfur' picture is not the whole story.
5. Modern elemental sulfur production is largely recovered during purification of oil and natural gas rather than mined as native sulfur.

Real-world context

Sulfuric acid

Most recovered sulfur ultimately supports sulfuric-acid production, a major industrial chemical used across fertilizers and manufacturing.

Biology

Sulfur is essential in amino acids such as cysteine and methionine and in many proteins and co-factors.

Rubber

Elemental sulfur is used in vulcanization to create crosslinks that change rubber's mechanical properties.

Minerals & volcanoes

Sulfur occurs as native sulfur in some volcanic settings and widely in sulfide and sulfate minerals.

Sulfur cycle

Microbes, oceans, soils, atmosphere and rocks exchange sulfur among many oxidation states and compounds.

Where on Earth? / geography modes

Sulfur cycle - Global biogeochemistry

Sulfur moves through rocks, oceans, soils, atmosphere and living systems in several chemical forms

Examples/context: Rocks; Oceans; Atmosphere; Life

Elemental sulfur recovery - Oil & gas purification

Modern sulfur supply is largely a co-product of removing sulfur compounds from fossil-fuel streams

Examples/context: Gas processing; Refineries; Sulfur recovery; Sulfuric acid

Natural occurrence - Minerals + volcanic settings

Native sulfur exists, but most crustal sulfur is bound in sulfide and sulfate minerals

Examples/context: Sulfides; Sulfates; Volcanoes; Evaporites

Isotopes

Isotope	Status / timescale	Why it matters
^{32}S	Stable · $\approx 95\%$ natural abundance	The dominant natural sulfur isotope; 16 protons and 16 neutrons.
^{34}S	Stable · $\approx 4.25\%$	An important minor isotope in geochemistry and isotope-ratio studies.
^{33}S / ^{36}S	Stable · minor natural isotopes	Together they make up a small fraction of natural sulfur and provide additional isotope tracers.

Evidence note

Atomic/isotope and ordinary physical values are measured/evaluated. Sulfur has many allotropes, so the molecular viewer intentionally shows an S_8 teaching molecule rather than pretending one molecule is the whole crystal. The phase path is approximate and explicitly notes allotrope-dependent melting behavior.

Review questions

How many valence electrons does neutral sulfur have?

Answer: 6. The valence shell is $3s^2 3p^4$.

What molecular ring is central to common room-temperature sulfur?

Answer: S_8 . Common α -sulfur is built from crown-shaped S_8 molecules.

Is sulfur a metal?

Answer: No · it is a nonmetal. Sulfur is a Group 16 nonmetal.

What is the largest industrial use of sulfur?

Answer: Sulfuric-acid production. Most sulfur is used to produce sulfuric acid.

What does the $\alpha \rightarrow \beta$ sulfur change represent?

Answer: A solid allotrope / crystal-structure transition. Sulfur can change solid structure before it melts.

Frequently asked questions

Is sulfur a metal or nonmetal?

Sulfur is a nonmetal in Group 16 of the periodic table.

How many valence electrons does sulfur have?

Six. Its ground-state configuration ends $3s^2 3p^4$.

What is sulfur used for?

The largest use is sulfuric-acid production; sulfur is also important in fertilizers, rubber vulcanization and many chemical processes.

What color is sulfur?

The common room-temperature allotrope appears yellow as crystals or powder.

Where is sulfur found?

Sulfur occurs as native sulfur in some settings and much more widely in sulfide and sulfate minerals and sulfur-bearing fossil resources.

Are sulfur and sulphur different elements?

No. 'Sulfur' is the IUPAC-preferred spelling, while 'sulphur' remains a common British spelling for the same element.

Sources used for this guide

- Royal Society of Chemistry - Sulfur

<https://periodic-table.rsc.org/element/16/sulfur>

- NIST - Atomic Data for Sulfur

<https://physics.nist.gov/PhysRefData/Handbook/Tables/sulfurtable1.htm>

- USGS - Mineral Commodity Summaries 2026

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

- IUCr - α/β sulfur structural transition

<https://journals.iucr.org/b/issues/2006/06/00/ws5045/>

This datasheet is a learning aid. Interactive 3D models are teaching models; uncertainty and predicted values must remain labelled. Search-demand data may guide explanation, but scientific values come from cited scientific sources.