

Fluorine (F) - Student Datasheet

Atomic number 9 - Halogen - nonmetal - Group 17 - Period 2 - p-block

Fluorine is element 9, the most electronegative element and a highly reactive Group 17 nonmetal. The core learning distinction is F atom versus F₂ elemental gas versus F⁻ fluoride ion: related labels, very different chemical objects.

Quick reference

Atomic number	9
Relative atomic mass	18.998
Electron configuration	[He] 2s ² 2p ⁵
State at 20 C	Pale yellow diatomic gas at 20 deg C
Density	0.001553 g/cm ³ - gas reference
Melting point	53.48 K
Boiling point	85.04 K
Common oxidation state	-1 in ordinary compounds
Electronegativity	3.98

Structure & orbitals

At ordinary conditions elemental fluorine is molecular F₂. The structure viewer shows a diatomic teaching model rather than a room-temperature crystal lattice.

The occupied 2s and 2p clouds are isolated-atom probability models. px/p/p_z controls change orientation only. The models do not depict the molecular orbitals of F₂ or electron density in fluoride solids.

Temperature / phase context

At approximately standard pressure, fluorine is solid below about 53.48 K, liquid to about 85.04 K, and gaseous above that point. Ordinary room-temperature elemental fluorine is F₂ gas.

Five things to remember

- Atomic number 9 means every fluorine nucleus contains 9 protons.
- Neutral fluorine has the ground-state configuration [He] 2s² 2p⁵.
- Fluorine is the most electronegative element on the Pauling scale.
- Ordinary elemental fluorine is F₂, a pale yellow, extremely reactive gas.
- Fluoride F⁻ is a chemically different ion with a closed-shell electron count.

Fluorine: Real World & Signature Science

Fluoride in minerals, water or toothpaste is not elemental fluorine gas. Fluorine's usefulness and hazards make sense only when the chemical species is identified correctly.

Why this element matters

Fluoride minerals Fluorine occurs naturally in minerals such as fluorite and fluorapatite, where it is present as fluoride in compounds.	Fluoropolymers Carbon-fluorine bonds help give fluorinated polymers distinctive chemical and thermal properties.
Uranium processing context Uranium hexafluoride is important in the nuclear fuel cycle; this page mentions the chemistry only at a high level and provides no operational enrichment guidance.	Dental chemistry Fluoride compounds can support tooth-enamel protection at appropriate controlled concentrations; this is fluoride-ion chemistry, not F ₂ gas.
Extreme reactivity Elemental F ₂ is a highly reactive toxic gas handled only in specialized systems.	

From fluoride minerals to fluorine chemistry: a high-level path

1. Fluorine is sourced from fluoride-bearing minerals, especially fluorspar, rather than from natural F₂ gas.
2. Industrial processing converts mineral fluoride into feed chemicals under tightly controlled conditions.
3. Specialized plants produce elemental fluorine or fluorinated intermediates for defined uses; this page intentionally omits operating procedures.
4. Final products include fluoropolymers, inorganic fluorides, pharmaceuticals and many other chemically distinct materials.

Where on Earth?

Fluoride minerals - Natural compounds

Fluorine occurs in compounds such as fluorite and fluorapatite rather than as free F₂ in Earth materials

Fluorspar production - 2025 commodity context

Selected major fluorspar-producing countries provide dated feedstock geography for fluorine chemistry

Fluorochemical chain - Conceptual

Mineral fluoride feedstocks are converted industrially into many different fluorine-containing chemicals and materials

History

1810 - Andre-Marie Ampere proposed that hydrofluoric acid contained an unknown element related to chlorine.

1886 - Henri Moissan isolated elemental fluorine after decades of difficult and dangerous attempts by chemists.

20th century - Fluorine chemistry expanded into refrigerants, polymers, uranium processing, pharmaceuticals and specialty materials.

Today - Fluorine-containing compounds are widespread in modern technology, while some fluorochemical classes receive increasing environmental scrutiny.

Uses

Fluoropolymers Strong C-F bonding contributes to low surface energy and chemical resistance in materials such as PTFE.	Inorganic fluorides Fluoride compounds are used in metallurgy, glass processing and specialized chemical manufacture.
Pharmaceuticals Fluorine atoms appear in many medicines because substitution can alter molecular properties.	Nuclear fuel-cycle chemistry UF ₆ provides a volatile uranium compound used in enrichment technology; operational enrichment details are outside scope.

Fluorine: Isotopes, Questions & Evidence

Isotopes

¹⁹F - Stable - essentially 100% natural fluorine

The only stable natural fluorine isotope; teaching nucleus has 9 protons and 10 neutrons.

¹⁸F - Radioactive - short-lived positron emitter

Used in regulated PET imaging chemistry; it is not part of ordinary natural fluorine abundance.

Fluorine isotope identity - One stable natural isotope

Natural fluorine's stable-isotope composition is essentially all ¹⁹F.

Common questions

What is fluorine's symbol?

Fluorine has the symbol F.

Is fluorine a metal?

No. Fluorine is a nonmetal halogen in Group 17.

What is fluorine used for?

Fluorine chemistry appears in fluoropolymers, inorganic fluorides, medicines and specialized industrial processes.

Is fluoride the same as fluorine gas?

No. F⁻ fluoride is an ion in compounds and solutions; F₂ is elemental fluorine gas and is far more reactive.

Why is fluorine so reactive?

Its small size and very high electronegativity strongly favor forming bonds and reaching a closed-shell electron configuration.

What is fluorine's electron configuration?

[He] 2s² 2p⁵. That gives seven valence electrons.

Quick self-check

1. What is fluorine's atomic number? Answer: 9
2. How many valence electrons does neutral fluorine have? Answer: 7
3. What is ordinary elemental fluorine? Answer: F₂ gas
4. Which statement is correct? Answer: Fluoride ion and fluorine gas are different chemical species
5. What is fluorine's characteristic oxidation state in ordinary compounds? Answer: -1

Evidence & provenance

Atomic and ordinary phase values are measured/evaluated. The molecule viewer is a simple F₂ teaching model.

Resource geography concerns fluoride minerals/fluorspar; it does not imply natural free fluorine gas at those places.

Core sources

Royal Society of Chemistry - Fluorine	https://periodic-table.rsc.org/element/9/fluorine
NIST - Atomic Data for Fluorine	https://physics.nist.gov/PhysRefData/Handbook/Tables/fluorinetable1.htm
USGS - Mineral Commodity Summaries 2026	https://pubs.usgs.gov/publication/mcs2026