Fluorine (F)

Element 9 — Complete Summary

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9
F
Fluorine
18.998

Key Properties

Atomic Mass	18.998
Category	Halogens
State at 20°C	gas
Melting Point	−219.67°C
Boiling Point	−188.11°C
Density	1.696 g/L
Electron Config	[He] 2s22p5
Electronegativity	3.98
Year Discovered	1886
Discovered By	Henri Moissan

✨ Did You Know?

1. It is the most electronegative and most reactive of all chemical elements; it is so reactive it can even form compounds with noble gases like xenon.
2. Fluorine gas is so aggressive that it can set substances like glass and water on fire.
3. It was incredibly difficult to isolate; it took chemists 74 years of continuous effort before Henri Moissan finally succeeded in 1886, for which he won a Nobel Prize.
4. The non-stick coating Teflon is a polymer made from carbon and fluorine atoms (polytetrafluoroethylene).
5. Hydrofluoric acid (HF), a solution of hydrogen fluoride in water, is one of the few substances that can dissolve glass.

APPEARANCE
A pale, corrosive, yellow-green gas.

SUPERHERO PERSONA
"The Corrosive Crusader, the most reactive and aggressive hero, who can force a bond with almost anyone."

EVERYDAY CONNECTION
The fluoride in your toothpaste that protects your teeth.

POP CULTURE
Hydrofluoric acid, derived from fluorine, is famously used to dissolve a body in 'Breaking Bad'.

Overview of Fluorine

Fluorine is a pale yellow-green gas and the most reactive element in the periodic table. With atomic number 9, it reacts violently with nearly all other substances—even steel wool will burst into flames in its presence. Because of this extreme reactivity, fluorine is never found in its pure form in nature, but its compounds are widespread and critically important in industry and daily life.

Uses of Fluorine

Despite its dangerous nature, fluorine's reactivity makes it a cornerstone of many modern technologies:

Nuclear power: Fluorine is used to produce uranium hexafluoride (UF_6), which is essential for separating uranium isotopes in nuclear fuel production.

High-performance plastics: Fluorine-based compounds are the basis of Teflon (PTFE), known for its non-stick properties in cookware. PTFE is also used in cable insulation, chemical-resistant coatings, and waterproof fabrics like Gore-Tex.

Electronics: Sulfur hexafluoride (SF_6), derived from fluorine, is used as an insulating gas in high-voltage transformers and electrical equipment.

Glass etching: Hydrofluoric acid (HF) dissolves silicates and is used in etching glass for light bulbs, lenses, and laboratory equipment.

Refrigerants: Fluorine compounds such as CFCs (chlorofluorocarbons) were once widely used in refrigeration and aerosols. Although now banned for damaging the ozone layer, safer fluorinated alternatives are still in use.

Biological Role of Fluorine

Fluorine as the free element is toxic, but its ion form, fluoride (F^-), is important in biology:

Dental health: Fluoride strengthens tooth enamel and helps prevent cavities. In many regions, small amounts are added to drinking water for this reason.

Bones: Fluoride contributes to bone strength, though excessive intake can lead to fluorosis.

In humans: The body contains about 2–3 mg of fluoride, mainly in bones and teeth.

Natural Occurrence and Production of Fluorine

Fluorine is the 13th most abundant element in Earth's crust. It is found in minerals such as fluorite (CaF_2) and cryolite (Na_3AlF_6).

Commercial fluorine is produced by electrolysis of potassium hydrogendifluoride (KHF_2) dissolved in hydrofluoric acid, the method first used to isolate it.

History of Fluorine

1812 – Naming: French scientist André-Marie Ampère coined the name fluorine from the mineral fluorite.

19th-century challenges: Many chemists, including Humphry Davy, attempted to isolate fluorine but fell ill due to its toxicity.

1886 – First isolation: French chemist Henri Moissan succeeded by electrolyzing potassium bifluoride dissolved in liquid hydrofluoric acid. His achievement won him the 1906 Nobel Prize in Chemistry.