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1. General Information

- Symbol: F
- Atomic Number: 9
- Atomic Mass: 18.998 u
- Group: 17 (Halogens)
- Period: 2
- Block: p-block
- Electron Configuration: $1s^2 2s^2 2p^5$
- Valence Electrons: 7
- Phase at Room Temperature: Gas

2. Isotopes of Fluorine

Isotope	Protons	Neutrons	Abundance	Notes
^{19}F	9	10	100%	Only stable isotope.

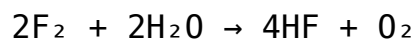
3. Physical Properties

- Color: Pale yellow
 - Odor: Pungent (in gaseous form)
 - Density: 1.696 g/L (at STP)
 - Melting Point: -219.62°C
 - Boiling Point: -188.12°C
 - State at STP: Gas
 - Molecular Form: F₂ (Diatomic)
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4. Chemical Properties

- Most Electronegative Element: 3.98 on the Pauling scale.
 - Highly Reactive: Reacts with almost all elements (including noble gases under certain conditions).
 - Strong Oxidizing Agent: Pulls electrons from other atoms.
 - Reacts Violently with Water: Forms hydrofluoric acid (HF) and oxygen.
 - Corrosive and Toxic in elemental form.
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Reaction with Water:



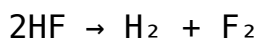
5. Occurrence and Abundance

- Rare as Elemental Fluorine (F₂): Highly reactive, never found free in nature.
- Found in Minerals:
 - Fluorite (CaF₂)
 - Cryolite (Na₃AlF₆)
 - Apatite (Ca₅(PO₄)₃F)

- Earth's Crust: 0.054% by weight.
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6. Industrial Production of Fluorine

- Electrolysis of Hydrogen Fluoride (HF):



- Source Materials: Fluorite (CaF_2) is used to produce hydrogen fluoride.
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7. Uses of Fluorine

Application	Description
Toothpaste and Water Fluoridation	Prevents dental cavities (as fluoride ions).
Refrigerants	Hydrofluorocarbons (HFCs), Teflon (PTFE).
Medicines	Fluorine-containing drugs (e.g., Prozac, Lipitor).
Nuclear Industry	Uranium hexafluoride (UF_6) for uranium enrichment.
Metallurgy	Used in aluminum refining (cryolite).
Rocket Propellants	Oxidizer in rocket fuel.
Non-stick Coatings	Teflon (polytetrafluoroethylene, PTFE).

8. Important Fluorine Compounds

Compound	Formula	Use
Hydrofluoric Acid	HF	Glass etching, metal cleaning.
Sodium Fluoride	NaF	Water fluoridation, toothpaste.
Uranium Hexafluoride	UF_6	Uranium enrichment for nuclear power.
Sulfur Hexafluoride	SF_6	Electrical insulator in circuits.
Fluoropolymers	PTFE (Teflon)	Non-stick cookware, electrical insulation.

9. Biological Role of Fluorine

- Not essential for life but important for dental health.
 - Strengthens tooth enamel by forming fluorapatite ($\text{Ca}_5(\text{PO}_4)_3\text{F}$).
 - Trace amounts are beneficial; excess can cause fluorosis (tooth discoloration).
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10. Fluorine in Environmental Chemistry

- Fluorinated Greenhouse Gases (F-Gases): Potent greenhouse gases like HFCs and SF_6 .
 - Persistent in Environment: Fluorine-based compounds are chemically stable and hard to break down.
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11. Safety and Hazards

- Highly Toxic and Corrosive:
 - Fluorine gas can cause severe burns on contact.
 - Inhalation is fatal even in small quantities.
 - Hydrofluoric Acid (HF): Penetrates skin, causing deep tissue damage and calcium depletion in bones.
 - Proper Handling:
 - Use protective gloves and eyewear.
 - Store in corrosion-resistant containers.
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Fun Facts About Fluorine:

- Fluorine is the most reactive element and can react with materials like glass and steel.
- The name “Fluorine” comes from the Latin word “fluere” meaning “to flow”.
- Teflon (PTFE), discovered by accident, is one of the best-known fluorinated materials.
- Fluorine compounds are used in 25% of all pharmaceuticals.