

# POISON TO PROMISE

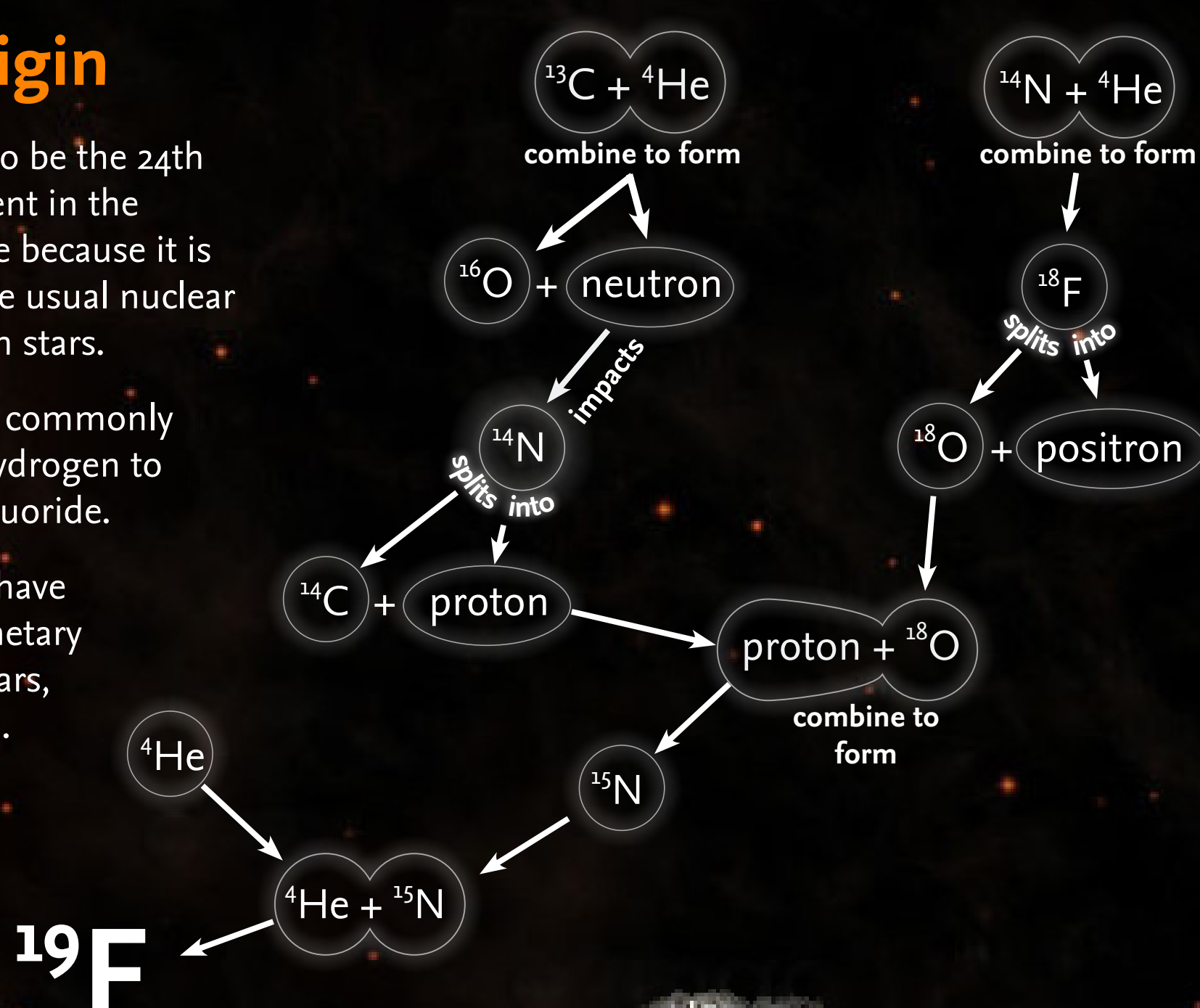
Fluorine is a highly toxic diatomic pale yellow gas. Thanks to the continued creativity of countless chemists, this extremely reactive gas was eventually transformed into a more utilizable form via electrolysis. This opened the doors for further experimentation and allowed chemists to incorporate this element into different molecules not found in nature. Doing so has resulted in compounds that are highly utilized and improve our daily lives.

## Fluorine's Origin

Fluorine is estimated to be the 24th most common element in the universe. It is so rare because it is not a product of the usual nuclear fusion processes in stars.

In space, fluorine commonly combines with hydrogen to form hydrogen fluoride.

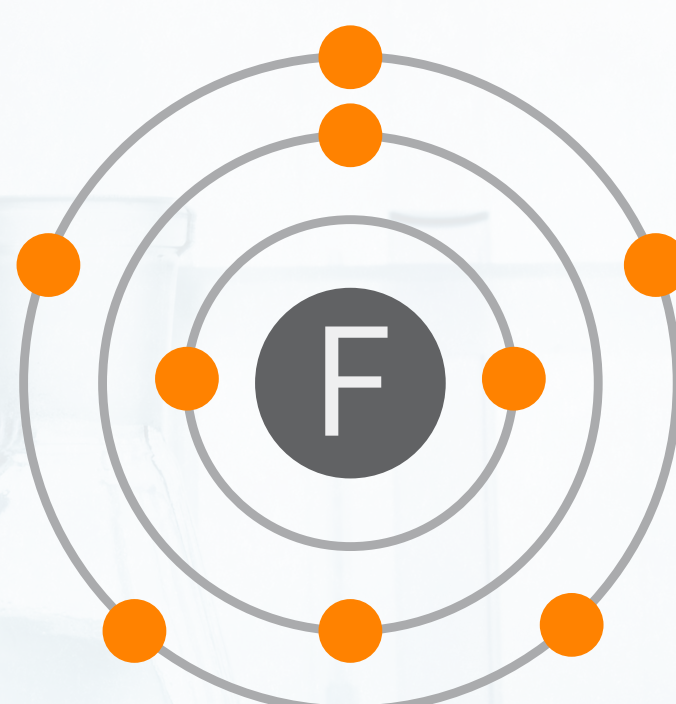
Fluorine cations have been seen in planetary nebulae and in stars, including our Sun.



## The Taming of the Fluorine

**Henri Moissan** Henri Moissan was a brave and intelligent scientist who was awarded a Nobel Prize in 1906 for discovering a way to isolate fluorine—requiring some rather unnerving experiments that involved the electrolysis of KHF<sub>2</sub> in neat HF (a very corrosive gas at room temperature). In the past, all attempts to isolate this element failed by other experimenters, some of which resulted in death.

Fluorine is the most electronegative element with a value of 3.98 on the Pauling electronegativity scale. Given that fluorine is one electron away from having a fully filled 2p electron orbital, and its relatively small size, the electrons are held very tightly to the nucleus, contributing to its high electronegativity.



**Henri Moissan**  
1852–1907



## Uses of Fluorine



### Toothpaste

Fluoride toothpastes make up more than **95%** of all toothpaste sales.



### Enhanced rocket fuel

Most liquid chemical rockets use two separate propellants: a fuel and an oxidizer. Oxidizers include nitric acid, nitrogen tetroxide, liquid oxygen, and liquid fluorine.

### Pharmaceuticals

Among the currently approved FDA pharmaceutical drugs, nearly one-third contain fluorine (this was a mere 2% in 1970), many of which are top-selling pharmaceuticals (e.g. Lipitor). Fluorine can impart many unique (and still unpredictable) chemical properties when attached to organic compounds of biological relevance. To name a few: increased lipophilicity, metabolic stability, and potency. Given fluorine's wide range of properties it has brought many attractive opportunities in drug design.

### Refrigerators

Fluorine is present in Freon which is used to keep refrigerators cold.



### Polytetrafluoroethylene (Teflon)

Polytetrafluoroethylene (PTFE) is a fluorocarbon polymer that was discovered in 1938 by accident when a chemist was attempting to make a chlorofluorocarbon refrigerant. A few applications include non-stick coating to frying pans, wiring (e.g coaxial cables), and Gore-Tex.





# POISON TO PROMISE

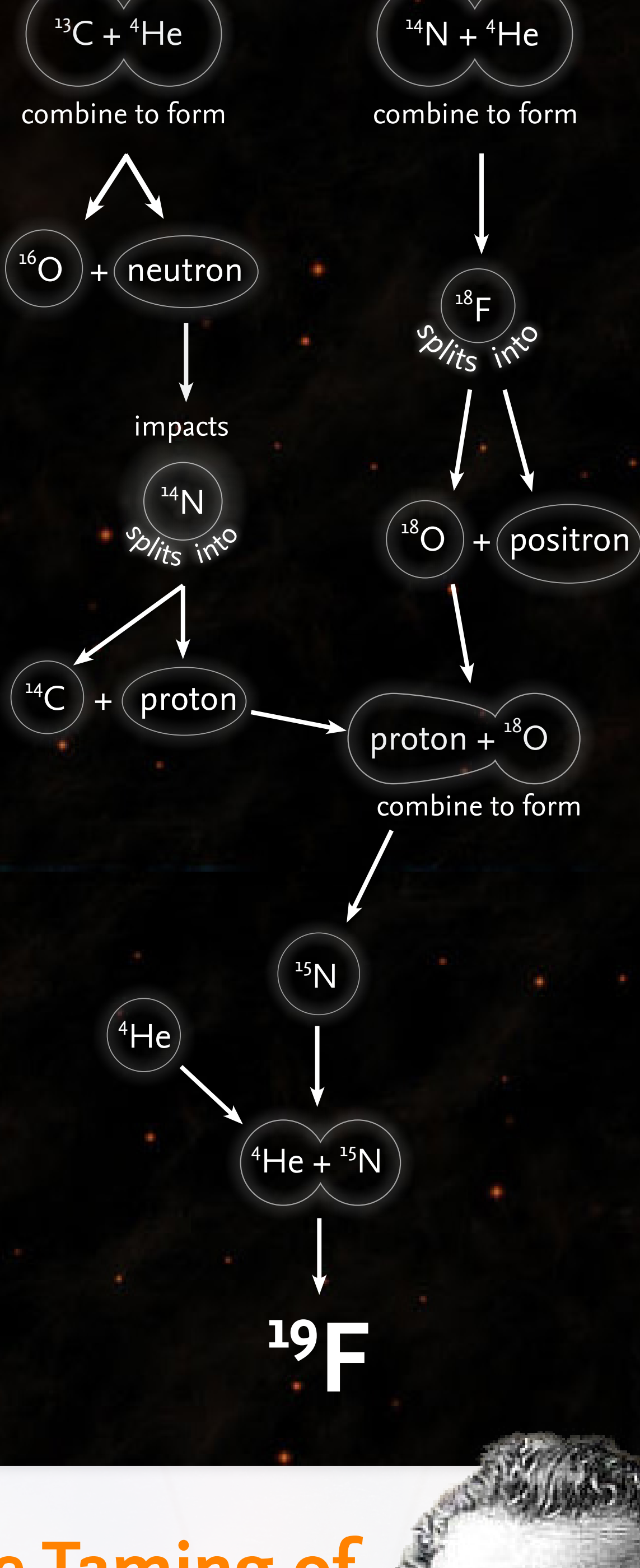
Fluorine is a highly toxic diatomic pale yellow gas. Thanks to the continued creativity of countless chemists, this extremely reactive gas was eventually transformed into a more utilizable form via electrolysis. This opened the doors for further experimentation and allowed chemists to incorporate this element into different molecules not found in nature. Doing so has resulted in compounds that are highly utilized and improve our daily lives.

## Fluorine's Origin

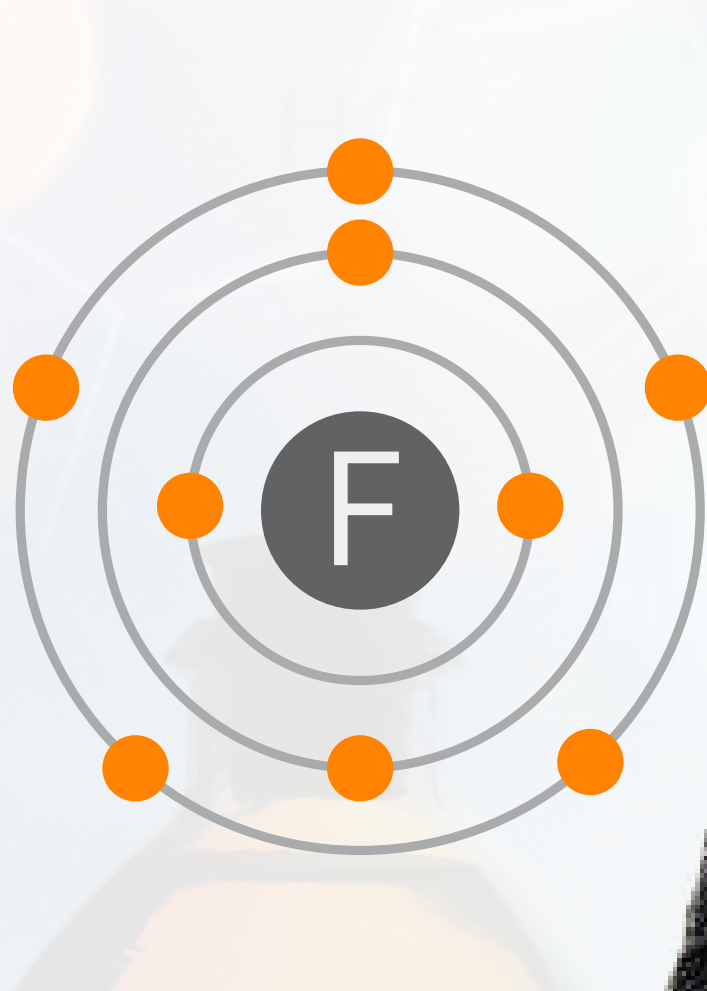
Fluorine is estimated to be the 24th most common element in the universe. It is so rare because it is not a product of the usual nuclear fusion processes in stars.

In space, fluorine commonly combines with hydrogen to form hydrogen fluoride.

Fluorine cations have been seen in planetary nebulae and in stars, including our Sun.



## The Taming of the Fluorine



**Henri Moissan**

1852–1907

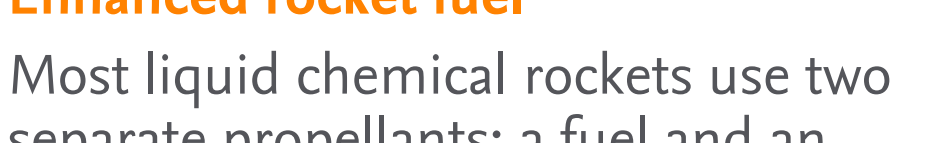
**Henri Moissan** Henri Moissan was a brave and intelligent scientist who was awarded a Nobel Prize in 1906 for discovering a way to isolate fluorine—requiring some rather unnerving experiments that involved the electrolysis of  $\text{KHF}_2$  in neat  $\text{HF}$  (a very corrosive gas at room temperature). In the past, all attempts to isolate this element failed by other experimenters, some of which resulted in death.

Fluorine is the most electronegative element with a value of 3.98 on the Pauling electronegativity scale. Given that fluorine is one electron away from having a fully filled 2p electron orbital, and its relatively small size, the electrons are held very tightly to the nucleus, contributing to its high electronegativity.

## Uses of Fluorine

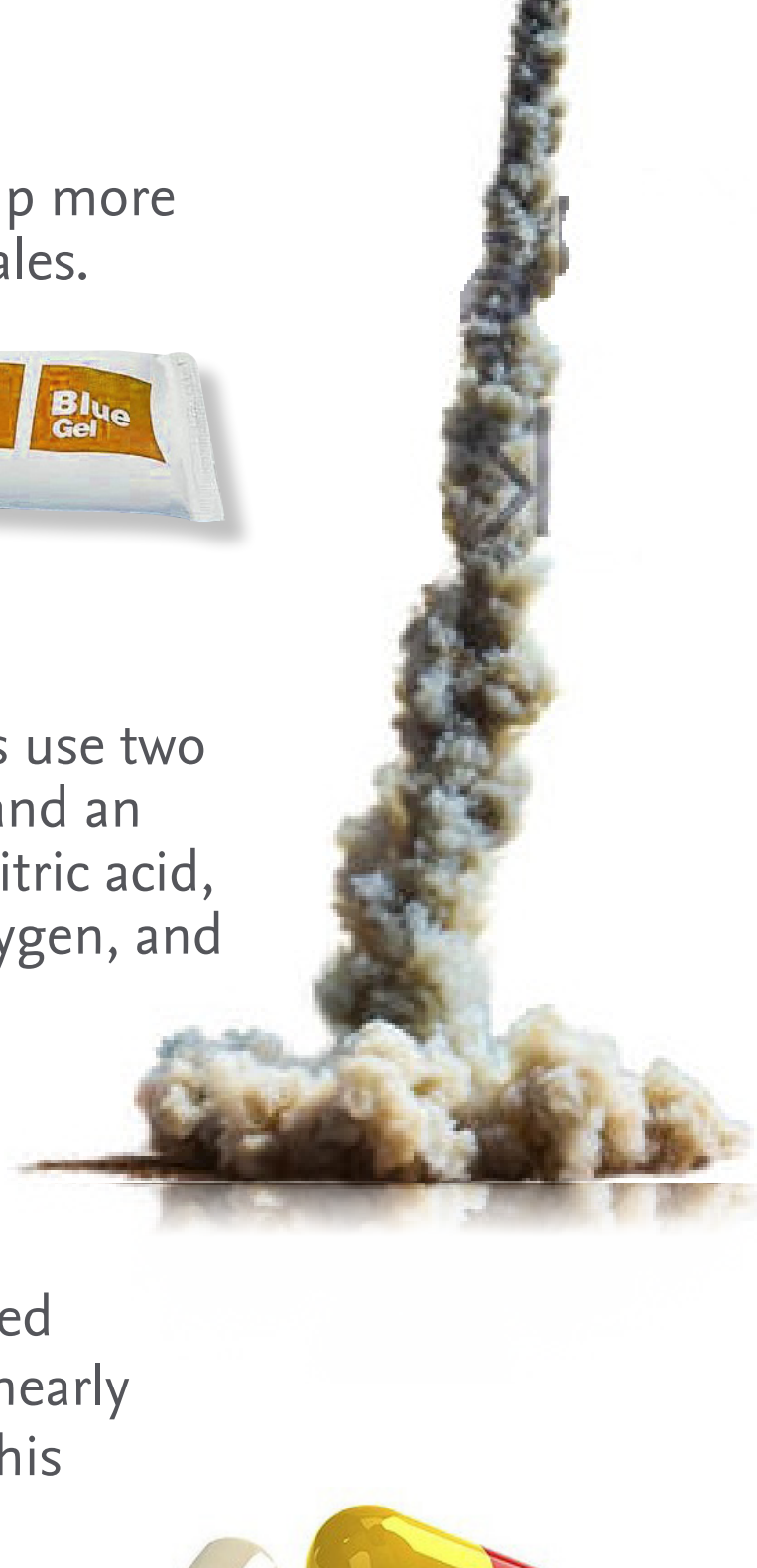
### Toothpaste

Fluoride toothpastes make up more than **95%** of all toothpaste sales.



### Enhanced rocket fuel

Most liquid chemical rockets use two separate propellants: a fuel and an oxidizer. Oxidizers include nitric acid, nitrogen tetroxide, liquid oxygen, and liquid fluorine.



### Pharmaceuticals

Among the currently approved FDA pharmaceutical drugs, nearly one-third contain fluorine (this was a mere 2% in 1970), many of which are top-selling pharmaceuticals (e.g. Lipitor). Fluorine can impart many unique (and still unpredictable) chemical properties when attached to organic compounds of biological relevance. To name a few: increased lipophilicity, metabolic stability, and potency. Given fluorine's wide range of properties it has brought many attractive opportunities in drug design.



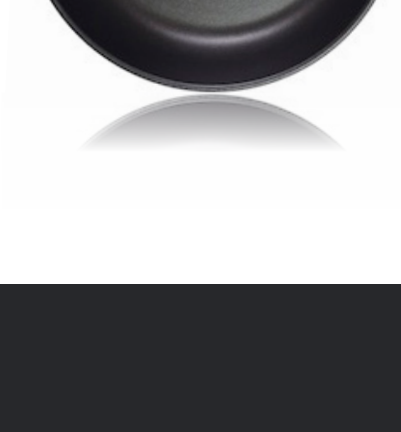
### Refrigerators

Fluorine is present in Freon which is used to keep refrigerators cold.



### Polytetrafluoroethylene (Teflon)

Polytetrafluoroethylene (PTFE) is a fluorocarbon polymer that was discovered in 1938 by accident when a chemist was attempting to make a chlorofluorocarbon refrigerant. A few applications include non-stick coating to frying pans, wiring (e.g. coaxial cables), and Gore-Tex.



Find out what Reaxys can do for you:

<https://www.elsevier.com/solutions/reaxys>

Follow Reaxys for all the latest news and information:

[f @elsevier.reaxys](#) [@Reaxys](#) [in /company/reaxys](#)