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C
Carbon
12.011

Key Properties

Atomic Mass	12.011
Category	Nonmetals
State at 20°C	solid
Melting Point	Sublimes at 3825°C
Boiling Point	Sublimes at 3825°C
Density	2.267
Electron Config	[He] 2s22p2
Electronegativity	2.55
Year Discovered	Ancient
Discovered By	Unknown

Did You Know?

- 1 It is the fourth most abundant element in the universe and is the fundamental building block for all known life on Earth.
- 2 Carbon exists in some of the softest (graphite) and hardest (diamond) known natural forms.
- 3 It is unique in its ability to form more chemical compounds than any other element, with almost ten million compounds discovered to date.
- 4 The age of ancient organic materials can be determined by measuring the amount of the radioactive isotope Carbon-14 they contain (radiocarbon dating).
- 5 Your body is about 18.5% carbon by mass.

APPEARANCE

Exists in many forms, from the transparent, hard diamond to the soft, black graphite.

SUPERHERO PERSONA

"The Shapeshifter, the ultimate hero who forms the basis of all life, appearing as the hardest diamond or the softest graphite."

EVERYDAY CONNECTION

The graphite ('lead') in your pencil.

POP CULTURE

The element that all known life is based on, a cornerstone of sci-fi biology.

Overview of Carbon

Carbon is a versatile non-metal and the chemical foundation of all known life. Its ability to form stable bonds in chains, rings, and complex structures allows for an immense variety of molecules, from simple gases to the building blocks of DNA. Pure carbon exists in several distinct forms, called allotropes, including graphite (a soft, black conductor) and diamond (the hardest natural material known).

Uses of Carbon

Carbon's different forms and compounds make it vital across industries and technologies:

Fossil fuels: Carbon is the main component of coal, oil, and natural gas. These hydrocarbons supply much of the world's energy, though their combustion increases atmospheric carbon dioxide and contributes to climate change.

Industrial uses: Charcoal and coke, impure forms of carbon, are key in smelting metals such as iron and steel. Graphite is used in pencils, furnace linings, and electric motors.

Advanced materials: Carbon fiber is extremely strong yet lightweight, making it ideal for aerospace, sporting equipment, and automotive industries.

Nanotechnology: Allotropes such as fullerenes, carbon nanotubes, and graphene have transformed materials science, with applications in electronics, coatings, and cutting tools. Industrial diamonds are also used for drilling, cutting, and polishing.

Purification: Activated charcoal filters water and air, and is used in respirators and medical treatments for poisoning.

Biological Role of Carbon

Carbon is essential for all living things. Its ability to form diverse molecules enables the chemistry of life:

Photosynthesis: Plants and photosynthetic organisms use sunlight to convert carbon dioxide and water into carbohydrates, releasing oxygen.

Food and energy: Animals and other organisms obtain carbon by consuming plants or other animals. Respiration then breaks down carbon-based molecules to release energy and recycle carbon dioxide back into the atmosphere.

Natural Occurrence and Production of Carbon

Carbon is abundant across the universe, present in stars, planets, and interstellar dust. On Earth, it exists in several forms:

Pure allotropes: Graphite is mined in many regions, while diamonds are found in kimberlite pipes, with major deposits in Russia, Canada, and Africa.

Compounds: Carbon occurs in all living organisms and in fossil fuels like coal, crude oil, and natural gas. It is also found in mineral carbonates such as limestone, chalk, and marble.

History of Carbon

Carbon has been used since prehistory, particularly in the form of charcoal and soot. The true nature of diamond was uncovered in 1796, when chemist Smithson Tennant proved that burning a diamond produced only carbon dioxide, confirming that it was a crystalline form of carbon.

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