Boron (B)

Element 5 — Complete Summary

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5
B
Boron
10.81

Key Properties

Atomic Mass	10.81
Category	Metalloids
State at 20°C	solid
Melting Point	2077°C
Boiling Point	4000°C
Density	2.34
Electron Config	[He] 2s22p1
Electronegativity	2.04
Year Discovered	1808
Discovered By	Joseph Louis Gay-Lussac & Louis Jacques Thénard

✨ Did You Know?

1. In its crystalline form, boron is the second-hardest element, surpassed only by carbon in the form of diamond.
2. Borosilicate glass (like Pyrex) is infused with boron, making it highly resistant to thermal shock and less likely to shatter when heated or cooled rapidly.
3. When added to fireworks, boron compounds burn with a distinctive bright green flame.
4. Boron is an essential nutrient for all green plants, playing a crucial role in strengthening their cell walls.
5. Boron nitride nanotubes are nearly as strong as carbon nanotubes but are much more resistant to heat and oxidation.

APPEARANCE
A hard, black, lustrous metalloid in its crystalline form.

SUPERHERO PERSONA
"The Glass Guardian, a hero who can withstand extreme heat and strengthen everything they touch."

EVERYDAY CONNECTION
Heat-resistant Pyrex glass cookware in the kitchen.

POP CULTURE
Mentioned in 'Star Trek' as a component in starship construction.

Overview of Boron

Boron is a dark, brittle, non-metallic element that appears as an amorphous powder in its pure form. Although relatively rare in Earth’s crust, its compounds are widely distributed and essential in many industries. With applications ranging from household cleaners to nuclear technology, boron is one of the most versatile elements in the periodic table.

Uses of Boron

The value of boron lies primarily in its compounds, which have diverse and useful properties:

Pyrotechnics: Amorphous boron produces a bright green flame, making it useful in flares and as an igniter in rocket fuels.

Household products: Borax (sodium borate) and boric acid are found in detergents, antiseptics, eye drops, and insecticides.

Glass and textiles: Boric oxide is vital in borosilicate glass (such as Pyrex), which is heat-resistant and strong. It is also used in fiberglass for textiles and insulation.

Flame retardants: Sodium octaborate and other boron compounds help reduce flammability in treated materials.

Nuclear technology: The isotope boron-10 absorbs neutrons efficiently, making it critical in nuclear reactor control rods and neutron-detection equipment.

Natural Occurrence and Production of Boron

Boron does not occur naturally in its pure elemental form. Instead, it is found in minerals such as borax, colemanite, and rasorite. Major deposits are located in California’s Mojave Desert and in Turkey.

Impure boron can be prepared by heating boron trioxide with magnesium. High-purity boron is obtained by reducing boron trichloride with hydrogen in industrial processes.

History of Boron

Early use: Borax was traded from Tibet for centuries and used by goldsmiths as a flux in metalworking.

1808 – Discovery: Two groups—Gay-Lussac and Thénard in Paris, and Humphry Davy in London—independently isolated boron by heating borax with potassium. Their samples, however, were impure.

Later refinement: Pure boron was finally prepared in 1892 by Henri Moissan and later by E. Weintraub in the United States, revealing its true characteristics.

Biological Role of Boron

Boron is a trace element required in small amounts for plant growth, particularly in strengthening cell walls. In humans, it may play a role in bone health, though it is not considered an essential nutrient. Excessive exposure to boron compounds, however, can be toxic.