

Neptunium (Np) - Student Datasheet

Atomic number 93 - Actinide - Group Actinide - Period 7 - f-block

Neptunium is element 93, the first transuranium element. Its science combines a long-lived isotope, multiple oxidation states and three solid allotropes-while all nuclear-material discussion stays high-level and non-operational.

Quick reference

Atomic number	93
Relative atomic mass	[237]
Electron configuration	[Rn] 5f4 6d1 7s2
State at 20 C	Radioactive silvery metal at 20 deg C
Density	20.2 g/cm3
Melting point	917 K
Boiling point	4175 K
Common oxidation state	+3, +4, +5, +6 (important states)
Electronegativity	1.3

Structure & orbitals

Neptunium has three established solid allotropes across temperature: alpha (orthorhombic), beta (tetragonal) and gamma (BCC). Viewers are teaching schematics; exact crystallographic coordinates are not implied.

The 5f/6d/7s orbital models show isolated-atom probability distributions. They do not encode radioactive decay, bulk allotrope energetics or chemical speciation.

Temperature / phase context

A reviewed heating-path teaching model shows alpha-Np (orthorhombic) to ~553 K, beta-Np (tetragonal) to ~850 K, gamma-Np (BCC) to melting near 917 K, then liquid toward the high boiling reference. Transition values vary somewhat among literature/conditions and are treated as teaching references.

Five things to remember

- Atomic number 93 means 93 protons.
- Neptunium has no stable isotopes.
- ²³⁷Np is long-lived, with a half-life of about 2.14 million years.
- Neptunium has alpha, beta and gamma solid allotropes before melting.
- Neptunium chemistry supports several oxidation states, especially +3 through +6.

Neptunium: Real World & Signature Science

Neptunium is primarily a research/nuclear-science element. Element Lookup explains measured atomic, isotope and phase behavior without providing material-production, separation or handling instructions.

Why this element matters

Research Neptunium is mainly encountered in nuclear and actinide research rather than everyday commercial products.	Nuclear measurement Neptunium isotopes and decay products are important in nuclear-forensics, fuel-cycle and environmental measurement contexts.
Oxidation-state chemistry Np can occur in several oxidation states, giving rich aqueous/coordination chemistry under controlled research conditions.	Phase science Three metallic allotropes make neptunium a strong example of temperature-dependent crystal structure.
Long-term radionuclide context Long-lived ^{237}Np matters in environmental and waste-performance assessments.	

How neptunium enters scientific study: non-operational overview

1. Neptunium isotopes can arise in irradiated nuclear material and decay chains; this page does not describe production settings.
2. Research laboratories characterize isotopes, oxidation states and materials using controlled radiological facilities.
3. Separation, purification and fabrication methods are intentionally excluded from this educational page.
4. Environmental and nuclear measurements focus on trace detection, isotope identification and long-term behavior.

Where on Earth?

Discovery + research

Berkeley anchors discovery history; modern research occurs in controlled institutions and inventories are intentionally not mapped.

History

1940 - Edwin McMillan and Philip Abelson produced and identified neptunium at Berkeley, the first transuranium element discovered.

1940s - Actinide chemistry developed rapidly as researchers investigated artificial heavy elements.

Later 20th century - Long-lived ^{237}Np became important in nuclear chemistry, environmental measurement and waste studies.

Today - Neptunium remains mainly a controlled research and nuclear-materials science topic.

Uses

Scientific research Neptunium supports actinide, nuclear-structure, spectroscopy and materials research.	Nuclear measurement Selected isotopes are relevant to analytical standards, monitoring and nuclear-science studies.
Environmental studies Long-lived ^{237}Np is studied in transport and waste-performance contexts.	No ordinary consumer use Neptunium has no routine bulk consumer application comparable with common structural metals.

Neptunium: Isotopes, Questions & Evidence

Isotopes

²³⁷Np - Radioactive - $t_{1/2}$ about 2.14 million years

Reference teaching nucleus: 93 protons and 144 neutrons.

²³⁹Np - Short-lived radionuclide

Important in the historical discovery chain and nuclear-decay studies.

Neptunium isotope context - No stable isotopes

All neptunium isotopes are radioactive; bracketed relative mass notation reflects this.

Common questions

What is neptunium's atomic number?

93.

What is neptunium's electron configuration?

[Rn] 5f⁴ 6d¹ 7s² is the standard ground-state reference.

Is neptunium a metal?

Yes. It is a radioactive actinide metal.

Does neptunium have stable isotopes?

No.

What is neptunium used for?

Mostly scientific/nuclear research and measurement contexts rather than ordinary consumer products.

Why are three solid structures shown?

Neptunium undergoes alpha -> beta -> gamma allotrope transitions as it is heated before melting.

Quick self-check

1. Atomic number? Answer: 93

2. Stable isotopes? Answer: None

3. Reference long-lived isotope? Answer: ²³⁷Np

4. Solid-allotrope sequence on heating? Answer: alpha -> beta -> gamma

5. What kind of guidance is intentionally excluded? Answer: Operational nuclear-material production/handling

Safety boundary

Neptunium is radioactive and radiotoxic. This page is strictly educational and non-operational: no synthesis, separation, purification, handling, inventory-location or criticality guidance.

Evidence & provenance

Atomic/isotope identity and metallic phase behavior are measured/evaluated. Transition temperatures are teaching references with condition/literature variation. No operational production, separation, criticality or material-access guidance is provided.

Core sources

Royal Society of Chemistry - Neptunium	https://periodic-table.rsc.org/element/93/neptunium
NIST - Atomic Data for Neptunium	https://physics.nist.gov/PhysRefData/Handbook/Tables/neptuniumtable1.htm
IUPAC / evaluated actinide references	https://www.ciaaw.org/neptunium.htm