

Rutherfordium (Rf) - Student Datasheet

Element 104 · Synthetic superheavy Group 4 element · source-reviewed learning reference

Rutherfordium is element 104, a synthetic superheavy member of Group 4. Nuclear decay establishes its identity, while atom-scale chemistry supports important similarities to zirconium and hafnium—without providing a measured bulk density, melting point or crystal lattice.

Quick reference

Atomic number	104
Relative atomic mass	[267]
Electron configuration	[Rn] 5f ¹⁴ 6d ² 7s ²
Period / group / block	7 / 4 / d
State context	Macroscopic bulk state not experimentally established
Density	Unknown
Melting / transition	Unknown
Boiling / gas reference	Unknown
Oxidation states	+4 experimentally supported in atom-scale chemistry; other states theory-dependent
Electronegativity	Unknown

Structure & orbitals

Rutherfordium has been studied atom-at-a-time. No macroscopic lattice is experimentally established, so the material viewer remains an evidence panel rather than extrapolating zirconium/hafnium structures.

The 6d/7s clouds are representative isolated-atom teaching forms. Superheavy electronic structure is strongly relativistic; these visuals are not measured bulk orbitals.

Phase behavior

No measured macroscopic phase boundaries exist for rutherfordium. The temperature explorer remains in an explicitly unknown state rather than inventing solid/liquid/gas transitions.

Five things to remember

- Atomic number 104 means 104 protons.
- Rutherfordium is synthetic and all known isotopes are radioactive.
- Atom-scale chemical experiments support Group 4-like +4 chemistry.
- Bulk density, melting point, boiling point and crystal structure are unknown.
- Discovery credit and naming involved long-running Dubna/Berkeley history; IUPAC adopted Rutherfordium.

Rutherfordium: Real World & Signature Science

Element-specific science, uses and history

Big idea

Rutherfordium demonstrates the difference between “we know its chemistry resembles Group 4” and “we have a chunk of the material.” The first has experimental support; the second does not exist.

Why this element is scientifically distinctive

Rotate a ^{267}Rf teaching nucleus and representative 6d/7s probability clouds, then use the Evidence Lens to separate measured decay/atom-scale +4 chemistry from unknown bulk material properties.

Nuclear identity	Rutherfordium isotopes are identified through nuclear-production and decay measurements.
Group 4 chemistry	Atom-scale experiments support tetravalent chemistry with similarities to Zr/Hf.
Discovery history	Both Dubna and Berkeley groups contributed to the discovery history and priority debate around element 104.
Naming	The name honors Ernest Rutherford and was adopted through IUPAC naming decisions.
Unknown bulk world	No macroscopic sample exists to establish crystal structure, density, appearance or ordinary phase boundaries.

How rutherfordium knowledge is built: atom-at-a-time evidence

1. Accelerator research produces extremely small numbers of superheavy atoms; operational synthesis parameters are outside this guide.
2. Decay chains establish isotope identity and nuclear properties.
3. Rapid chemical experiments can test adsorption/solution behavior before atoms decay.
4. Theory and periodic comparison interpret sparse measurements, while bulk properties remain explicitly unknown.

History checkpoints

1960s	Dubna and Berkeley teams reported production of element 104 isotopes in separate experiments.
1970s–1990s	Discovery priority and naming were debated internationally.
1997	IUPAC adopted the name rutherfordium (Rf) as part of the final naming resolution for elements 101–109.
Modern research	Atom-scale chemical studies support Group 4-like behavior.

Rutherfordium: Isotopes, Questions & Evidence

Evidence status and learner self-check

Isotope context

²⁶⁷ Rf	Radioactive superheavy isotope	Reference teaching nucleus with 104 protons and 163 neutrons.
²⁶¹ Rf	Radioactive isotope	Used in some chemical/nuclear studies.
Rutherfordium isotope context	No stable isotopes	All known isotopes are radioactive and synthetic.

Common questions

What is rutherfordium?

Rutherfordium is synthetic element 104, placed in Group 4.

Who discovered rutherfordium?

Discovery history involves both Dubna and Berkeley experiments; priority was historically disputed.

What is rutherfordium used for?

Fundamental nuclear and atom-scale chemical research only.

Is rutherfordium a metal?

It is classified as a Group 4 transition element and its chemistry supports metal-like Group 4 behavior, but no macroscopic metal sample has been measured.

Quick self-check

Q: What is rutherfordium's atomic number? | Answer: 104. Atomic number equals proton count.

Q: What chemistry has experimental support? | Answer: Group 4-like +4 chemistry. Rapid atom-scale chemistry supports tetravalent behavior.

Q: What is the measured melting point? | Answer: Unknown. No macroscopic melting measurement exists.

Evidence & safety

Element identity and decay are experimental. Atom-scale chemistry supports Group 4 +4 behavior. Bulk density, phase boundaries and crystal structure remain unknown; no lighter-element lattice is copied into the viewer.

Rutherfordium exists only in specialized superheavy-element research. No synthesis, beam settings, target preparation, separation or handling guidance is provided.

Core sources

Royal Society of Chemistry - Rutherfordium

<https://periodic-table.rsc.org/element/104/rutherfordium>

IUPAC - Periodic Table / element naming resources

<https://iupac.org/what-we-do/periodic-table-of-elements/>