

from triads to atomic number, and the trends that follow from electron arrangement

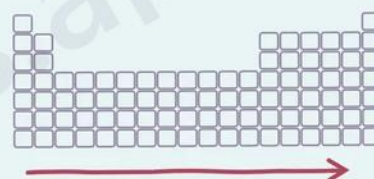
The early attempts, and why each failed

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- Dobereiner's triads : groups of three where the middle atomic mass is the average of the other two. It worked for only a few sets and most elements fitted none
- Newlands' octaves : every eighth element repeats a property, like notes of music. It broke down after calcium and assumed no new elements would be found
- Mendeleev arranged elements by increasing atomic mass and grouped those with similar properties
- his great strength was leaving gaps for undiscovered elements and predicting their properties, which were later confirmed
- his difficulties: hydrogen had no fixed place, isotopes of one element would need separate places, and a few pairs sat in the wrong order of mass
- cobalt at 58.9 had to be placed before nickel at 58.7, contradicting his own ordering rule

The modern periodic law

- Moseley showed that atomic number, not atomic mass, is the fundamental property of an element
- the modern periodic law : properties of elements are a periodic function of their atomic numbers
- reordering by atomic number fixed every one of Mendeleev's problems at once, including the cobalt and nickel pair
- isotopes have the same atomic number, so they now take a single place, which resolves that difficulty too
- the modern table has 18 groups and 7 periods
- the group number relates to the valence electrons and the period number to the number of shells, so the table's shape follows directly from electron arrangement



the table with an arrow running along a period: moving that way the atomic number climbs one at a time while the number of shells stays the same, which is what makes every trend along a period behave the way it does

The trends, across and down

Property	Across a period	Down a group
Atomic radius	decreases	increases
Metallic character	decreases	increases
Electronegativity	increases	decreases
Valence electrons	increases	stays the same
Number of shells	stays the same	increases

the last two rows explain the first three. Along a period the shells stay put while the nuclear charge grows, pulling the electrons in tighter; down a group a whole new shell is added each time, pushing the outer electrons further out