The periodic table

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2019 is the International Year of the Periodic Table, being 150 years since the generally accepted discovery of the periodic system for classifying the elements by Dmitry Mendeleev. Naturally, this is an apposite topic for a School Science Review themed issue. The periodic table is clearly utterly fundamental to science in general and chemistry in particular, and yet, if there was ever a scientific artefact that hides in plain sight so much that we almost grow to see through it, it is the standard classroom wallchart periodic table. As we start senior school, it is a glanced-at curiosity on the wall of the exciting chemistry laboratory to which we have recently gained admission, but the intricacies and curiosities contained therein almost certainly elude all but the most curious of early-years high school pupils.

The periodic table is chimera-like in being at both ends of the entropy scale simultaneously. It seems very symmetrical and organised (for example, the orderly manner in which similar elements neatly sit together in columns) on the one hand while sometimes appearing asymmetrical and random on the other (for example, the way in which the relative abundances are unrelated to atomic number and the distribution of solids, liquids and gases, and the relative distribution of metals, metalloids and non-metals).

There seem to be two orphaned rows of elements, the lanthanides and actinides, all alone underneath the table, forlornly cast out from the main body of the table. This is everything to do with graphic design and nothing to do with chemistry; if the lanthanides and actinides were put to the right of lanthanum and actinium where they belong, we would have a table that is very wide compared with its height.

The periodic table showcases all known elemental matter that exists or can exist in the universe, and the lay person might be unaware that it continues to grow, as ever more elusive elements are discovered. More accurately, some of the most recent new elements are never observed owing to their very short half-lives. Examination of their decay products allows the discoverers to extrapolate back to the new element.

The four most recent discoveries are:

- nihonium, Nh, element 113;
- moscovium, Mc, element 115;
- tennessine, Ts, element 117;
- oganesson, Og, element 118.

The last of these provides only the second example of an element being named after a still-living person, with the first example being seaborgium.

Some brief factoids include:

- There are 118 confirmed elements, of which around 95 are (or are predicted to be) metals. The remaining 23 elements are metalloids (seven) or non-metals (16).
- At room temperature, there are 86 solids, two liquids, 11 gases and 19 for which we don't know the phase. At blood temperature, the number of liquids goes up by two with the addition of gallium (melting point 29.76 °C) and caesium (28.44 °C).
- The relative abundance of the elements in the universe is another paradox. It would be intuitive if the smallest element was the most abundant (it is) and then successive abundances neatly decreased with size. And yet while hydrogen and helium occupy the top abundance spots with 74% and 24% respectively, lithium through to nitrogen are missed until we get to oxygen (0.1%) and we then go back to carbon (0.04%). Surprisingly (for a rare gas), the next most abundant is neon (0.04%) and the series finishes in order of iron (the first metal), nitrogen, silicon, magnesium and sulfur (Table 1).

Table 1 Relative abundance of the top ten most ubiquitous elements in the universe; source: https://en.wikipedia.org/wiki/Abundance_of_the_chemical_elements, confirmed by: https://periodictable.com/Properties/A/UniverseAbundance.html

Atomic number	Element	Mass fraction (ppm)
1	Hydrogen	739 000
2	Helium	240 000
8	Oxygen	10 400
6	Carbon	4 600
10	Neon	1 340
26	Iron	1 090
7	Nitrogen	960
14	Silicon	650
12	Magnesium	580
16	Sulfur	440

Fittingly, we commence the first part of our periodic table journey (the second part will be in December's themed issue of *SSR*) with an article by one of the titans of periodic table commentary, John Emsley, who gives an absorbing overview and history of the development of the periodic table in his piece 'A dream of a table'. We then have two articles dealing with specific elements, coincidentally in the same group, one atop the other – David Timson describes the role of calcium in signalling in biological systems, followed by Stewart Glaspole's account of the rise and fall of strontium as a therapeutic agent and the importance of pharmacovigilance. The chemistry raconteur Gordon Woods then tells us of his experiences in disseminating the periodic table while dressed as Mendeleev, and then Keith Ross looks at the novel approach of using waste and recycling as a way in to the periodic table. We then return to single-element articles with the father-and-son team of Peter and Alexander Cragg who consider intriguing aspects of the simplest and most abundant element, hydrogen. Tippu Sheriff then focuses on a discoverer rather than a discovery when he semi-biographises the maverick chemist Joseph Priestley. We are then reminded that there are several ways of presenting the periodic table by Gavin McNeill, who outlines some of the alternative iterations in 'A periodic obsession'. Keith Ross then returns with some controversial science when he opines that hydrogen goes with carbon in the periodic table, before we are treated to a review of the literature concerning the periodic table by David Read and Amelia Pullinger. Lastly, the quartet that is Greg Scutt, Aren Okello, Railton Scott and Michael Hal Sosabowski give an overview of elements that contribute to the effectiveness of medicines and other healthcare interactions in 'The periodic table of medicine'.

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