

#IYPT2019

As the 150th anniversary of Dmitri Mendeleev's discovery of the Periodic System, 2019 has been proclaimed the **International Year of the Periodic Table of Chemical Elements** by the UN General Assembly and UNESCO.

Genius in its simplicity and still learnt by schoolchildren today, the Periodic Table of Chemical Elements is instantly recognisable. Events throughout 2019 will celebrate the discovery, find one near you here www.iypt2019.org

In this issue, we focus on the six elements considered essential for life on Earth. Each of the boxes herein lists recent articles exploring the molecular bioscience of these key elements.

¹Hydrogen

A single electron orbiting a single proton, H₂ is involved in many biochemical reactions, including photosynthesis and respiration.

- Analysis of PI3K inhibitors by bottom-up electron-transfer dissociation hydrogen/deuterium exchange mass spectrometry <https://bit.ly/2RxJ701>
- For more on hydrogen bonds check out the features from Steve Scheiner (pg 6) and our look back with Steve Harding (pg 38).



²⁰Calcium

Forming Ca²⁺ ions, calcium has many crucial roles at the molecular level:

- Ca²⁺ regulates connexin43 gap junction communication <https://bit.ly/2J35BUc>
- It is essential for cell function and signalling, find out more from Holly Smith (pg 28).
- Signal for stomata closing in plants <https://bit.ly/322P9uh>
- Required for cell division as necessary in the formation of the mitotic spindle <https://bit.ly/2KTY2kG>
- Mitochondrial calcium signalling has implications in neuro-degenerative diseases <https://bit.ly/2FK7ovb>
- Calcium and Ca²⁺/Calmodulin-dependent kinase II could be targets for helminth parasite control <https://bit.ly/2FF3B2f>



Create your own Periodic Table

Allowing you to customise your own periodic table, focusing on the properties important to you, Moscow-based design company Art. Lebedev Studio have released an online tool, freely available here <https://www.artlebedev.com/mendeleev-table/>

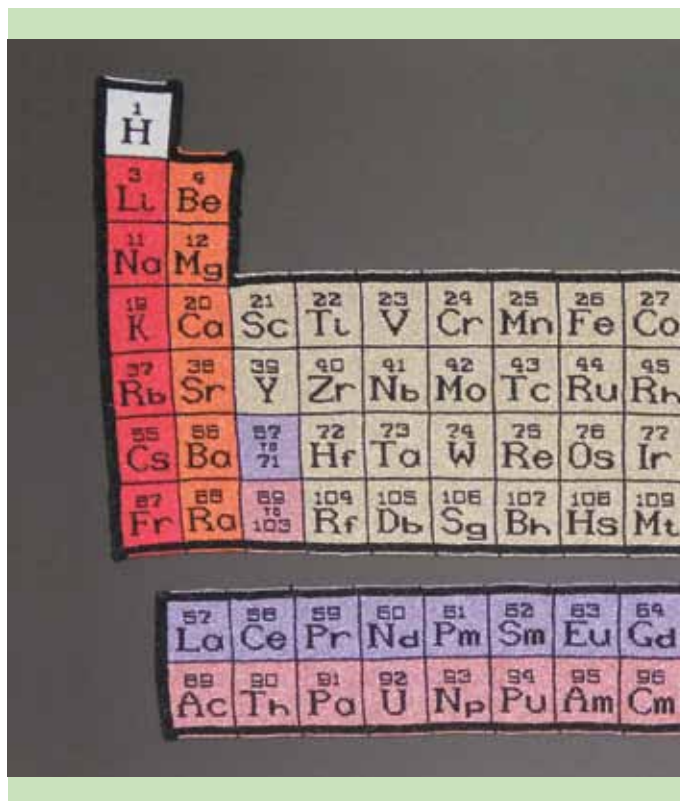
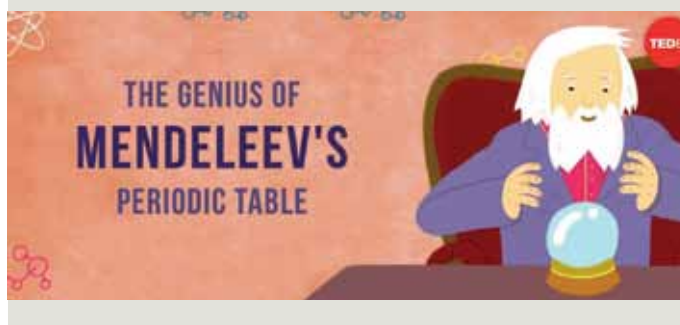


United Nations
Educational, Scientific and
Cultural Organization



2019
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Find out why Mendeleev's design is considered genius here
<https://bit.ly/2FNQOdY>



⁶Carbon

CCarbon
12.011

Carbon is tetravalent, able to form strong covalent chemical bonds with other atoms, and forms essential organic molecules, including sugars, amino acids and fats.

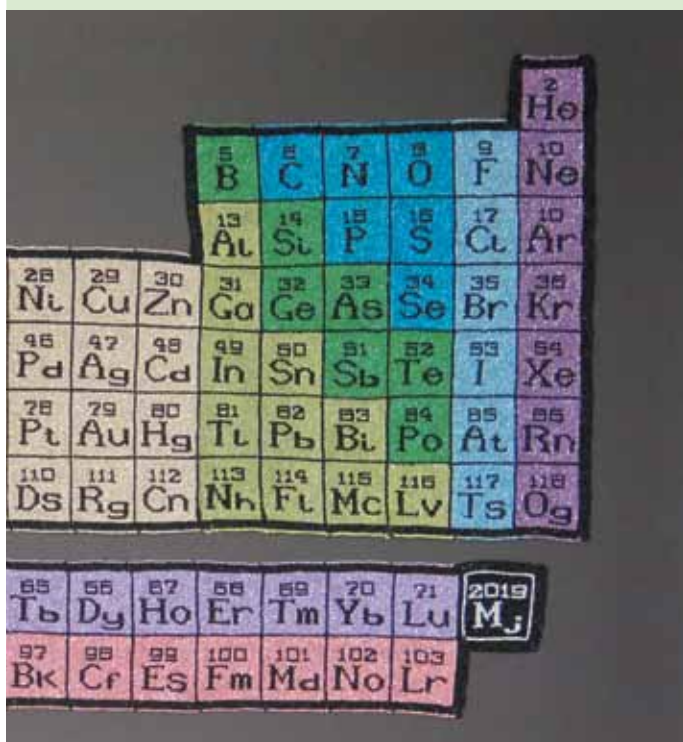
- Plants 'fix' carbon during photosynthesis, using the energy in sunlight <https://bit.ly/2ZUL6yu>
- Cellular respiration allows organisms to convert the biochemical energy from sugars into ATP (see below).
- Methanogens are archaea that metabolically convert carbon into methane <https://bit.ly/2xpwE5m>
- Carbon can also form nanotubes, structures with amazing potential, as discussed by YuHuang Wang, Benjamin Barnes and Alexandra Brozena (see pg 10).

Macramé on Tour

The artwork below is a photo of a macramé piece made by Jane Stewart and photographed by Dr Helen Stewart. Jane's larger portfolio of work can be viewed here <https://bit.ly/2YPUkfo>

If you would like to see this piece, it is currently on tour around the UK and will be available at the following places:

- 13-30 August – Royal Society of Chemistry, London
- 20 September – Oxford University Open Day
- 28 September – University of Edinburgh 'Doors Open Day'
- 6 October – University of St Andrews
- 16 October – University of Dundee Festival of the Future



⁷Nitrogen

NNitrogen
14.007

- Do nitric oxide, carbon monoxide and hydrogen sulfide really qualify as 'gasotransmitters' in bacteria? <https://bit.ly/2XiQEpj>
- Manipulating nitrogen regulation in diazotrophic bacteria for agronomic benefit <https://bit.ly/2FKuSUS>
- Edward Cocking and David Dent explore Nitrogen fixation in plants (pg 14).

⁸Oxygen

OOxygen
15.999

- Making up around 21% of the air we breathe, the oxygenation of the atmosphere changed our planet <https://bit.ly/2J3HcOB>
- The absence of oxygen is called hypoxia and can be used therapeutically <https://bit.ly/2xpp1vO>
- Climate change may turn octopuses partially blind from lack of oxygen <https://bit.ly/2KSe5Q2>
- Although essential for aerobic life, is oxygen our foe – Ian Max Møller and Kim Hebelstrup explore (pg 18).

¹⁵Phosphorus

PPhosphorus
30.973761998

- Phosphorus forms part of adenosine triphosphate (ATP), the most important energy-transfer molecule in all living cells.
- A key biochemical event is the (de)phosphorylation of substrates by enzymes <https://bit.ly/2JldtPJ>
 - The secret life of kinases: insights into non-catalytic signalling functions from pseudokinases <https://bit.ly/2LuNHeE>
 - Plastidic glucose-6-phosphate dehydrogenases are regulated to maintain activity in the light <https://bit.ly/2LtcPal>
 - The phosphoanhydride bond is a cornerstone of life – Werner Müller, Heinz Schröder and Xiaohong Wang explore further (pg 22).
 - The molecular basis of sleep need is tracked via the addition of phosphate groups <https://go.nature.com/2JV1xX9>

Closing the last gap for the Periodic Table's 150th birthday

PmPromethium
145

In July 2019, one of the last remaining gaps in the periodic table has been closed by the discovery of a critical property for the element Promethium, a rare, glow-in-the-dark, and highly radioactive element. Dr Ulli Köster, Research Scientist, Institut Laue-Langevin (ILL) says: "Our research has enabled the first experimental determination of the ionization energy of promethium. It closes the last remaining gap in the periodic table for this fundamental property." Mendeleev predicted that the evident gaps in his system would eventually be filled. <https://bit.ly/2Xnktk7>