



Perspective

**World Environment Day and
the role of chemistry for sustainability**

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[World Environment Day](#) on 5 June 2019 is an occasion for sober reflection on the massive challenges that need to be overcome to avert serious damage to our environment and the severe impacts of this damage on our lives, health and livelihoods. Preparing for the [Climate Action Summit](#) in September 2019, UN Secretary General António Guterres has emphasised this is a [global emergency](#) and that “*the time for action is now*”.

The nature of the threats and consequences is increasingly well documented. Global warming driven by greenhouse gases resulting from human activities is likely to [exceed](#) the desired maximum 1.5°C rise above pre-industrial levels and [may reach 4°C rise](#) by the end of the 21st century. Unprecedented [rates of extinction of biological species](#) are occurring as deforestation, agricultural practices and pollution take their toll. [Urban environments grow increasingly unhealthy](#) due to emissions from road traffic, industry and indoor burning of fuels – and World Environment Day 2019, hosted by China, focuses on the theme of [air pollution](#). [Management of waste](#) of all kinds has become a [global problem of massive proportions](#) and the particular challenge of [waste plastics](#), which account for around 12% of the global total, has been [highlighted](#).

The immediate choices are both political and personal, entailing decisions about curtailing growth processes, changing patterns of consumption and balancing the economic and lifestyle impacts of these decisions on present and future generations. However, the options available depend on the science and technology that can enable the world to move to a pathway of sustainability. Chemistry is central to creating, evaluating and implementing these options. Chemists everywhere must rise to the challenge and contribute to finding solutions. As the science that deals with the analysis, synthesis and transformation of matter, chemistry can deliver the molecular basis of sustainability. This includes developing:

- more sensitive, fast and economic tools for detecting pollutants, including on-site in the environment
- alternative sources of energy that do not cause atmospheric pollution
- new structural and packaging materials that do not deplete non-renewable reserves or pollute the environment during their manufacture, use or disposal phases.
- efficient and environmentally protective means for the collection and management of waste, with an emphasis on reducing waste as far as possible and on the reuse and recycling of materials wherever practicable.

As scientists associated with the [Chemists for Sustainability](#) action group of the International Organization for Chemical Sciences in Development (IOCD), we have emphasised ways that chemistry needs to contribute to sustainable development. In particular:

- Chemistry must undergo major reorientation in order to contribute optimally to achieving the UN Sustainable Development Goals.

[The role of chemistry in inventing a sustainable future](#). *Nature Chem* 2015, 7, 941-943.

[Die globale Verantwortung der Chemie](#). *Nachrichten aus der Chemie*, 2016, 64, 547-548.

[Repositionnement des sciences chimiques en vue de créer un avenir durable](#). *Chimie Nouvelle* 2018, 127, 21-31.

[Repositioning the chemical sciences for a sustainable future](#). *Chimie Nouvelle* 2018, 128, 17-27.

- The concept of ‘one-world chemistry’ (OWC) has been presented as a new orientation for the discipline. OWC *emphasises the need for chemistry to be a science for the benefit of society, embracing the understanding that human health, animal health and the environment are all interconnected. Acting on the consequences requires ethical behaviour at all times, the employment of systems thinking in relation to all aspects of the practice of chemistry, and strengthening the capacity of chemistry for cross-disciplinary working.*
[‘One-world’ chemistry and systems thinking](#). *Nature Chem* 2016, **8**, 393-6.
[Chemie für die eine Welt](#). *Nachrichten aus der Chemie* 2016, **64**, 1190-1191.
[Die Rolle der chemischen Wissenschaften im 21. Jahrhundert - one-world chemistry](#). In: T.K. Lindhorst, H.-J. Quadbeck-Seeger, Gesellschaft Deutscher Chemiker, *Unendliche Weiten: Kreuz und quer durchs Chemie-Universum*. Weinheim: Wiley-VCH 2017, 183-188.
[One-world chemistry and the quest for global sustainability](#). *Chem. Soc. Japan: Chemistry and Chemical Industry*, 2017, **10**, 873-875 ([English](#)); 876-878 ([Japanese](#)).
- The reforms in chemistry, including the OWC approach, advocated call for the *adoption of systems thinking by chemistry*. In collaboration with Peter Mahaffy (The Kings University, Edmonton, Canada), the group has set out the case for chemistry education to adopt systems thinking and pointed to pathways through which this can be achieved.
[One-World Chemistry: Implications for Education](#). *International Organization for Chemical Sciences in Development*, September 2017, 6p.
[Reorienting chemistry education through systems thinking](#). 2017, *Nature Chemistry Reviews*, 2018, **2**, 1-3; doi:10.1038/s41570.018.0126.
[Learning Objectives and Strategies for Infusing Systems Thinking into \(Post\)-Secondary General Chemistry Education](#). IUPAC Project No. 2017-010-1-050, 2017-2019.
[Systems thinking for educating about the molecular basis of sustainability](#). *Nature Sustainability* 2019, **2**, 362-365, doi: 10.1038/s41893-019-0285-3.
[Earth emergency: Systems thinking, chemistry education and sustainability](#). Perspective, *International Organization for Chemical Sciences in Development*, Namur, published online 15 May 2019.
- According to the group, we need to stop thinking of any materials as being waste and the very concept of waste matter should disappear. The Earth has finite stocks of the 80 elements that are stable and we need to learn how to conserve and manage these stocks and how to avoid dispersing them in ways that contaminate the environment and make them unrecoverable for future re-use.
[Waste does not exist: there is only post-trash](#). *SciDev.Net*, published online 22 April 2019.
[The simple matter of sustainability](#). *Current Science* 2019, **116**, 7-8.
[The periodic table of the chemical elements and sustainable development](#). *European Journal of Inorganic Chemistry* 2019, published online 28 March 2019, doi: 10.1002/ejic.201801409,

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Recommended citation:

A. Krief, H. Hopf, G. Mehta, S. A. Matlin. *World Environment Day and the role of chemistry for sustainability*. International Organization for Chemical Sciences in Development, Namur, posted online June 2019. <http://www.iocd.org/perspectives>