



International Organization
for
Chemical Sciences in Development

Perspective

**Earth emergency:
Systems thinking, chemistry education and sustainability**

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The latest UN [report](#) from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) shows that we are losing biological species at an unprecedented rate, with 1 million species being threatened in what is becoming recognised as the Earth's [6th mass extinction](#). On our present trajectory, global warming driven by emissions of greenhouse gases is likely to [exceed](#) the desired maximum 1.5°C rise above pre-industrial levels. [Estimates](#) suggest it may reach 4°C rise by the end of the 21st century, with consequences for many regions of their habitability, their viability of agriculture and their risks of extreme weather events. The [Great Acceleration](#) in the rate of change of environmental indicators that has been seen over the last several decades is propelling the planet towards tipping points, and possible even a [domino effect](#), that may irretrievably alter the Earth's biosphere for the next 10,000 years. It is not surprising that alarm bells are being sounded, that young people have been taking to the streets to demonstrate for action to secure their future, that the UK Parliament has passed a motion declaring an environment and [climate change emergency](#), and that the UN is preparing for crisis talks at the [Climate Action Summit](#) in September 2019. This year has been described as a [critical time](#), the “last chance” for the international community to take effective action on climate change.

Solutions to these critical challenges are within our grasp. The Secretary General and the General Assembly President of the UN have [stated](#) that “we are the last generation that can prevent irreparable damage to our planet”. There is still a window of opportunity in the next decade or two to halt these trends and avoid the tipping points.

There are major roles for chemistry in helping to overcome the challenges, prevent the worst damage that could occur from the environment changes now in progress, and assist the world towards a pathway of sustainability. Chemistry, as the science that deals with the analysis, synthesis and transformation of matter, can deliver the molecular basis of sustainability. But to do so effectively, chemists must develop the capacity to connect their work with Earth and societal systems and place it in the context of the possible impacts of chemistry processes and products.

Consequently, there is an urgent need for chemists to be able to engage in [systems thinking](#). An international group of chemistry educators are engaged in a [project](#) of the International Union of Pure and Applied Chemistry, also supported by the International Organization for Chemical Sciences in Development, to introduce systems thinking into general chemistry education at the school and university levels. Members of the group, Peter Mahaffy, Stephen Matlin, Thomas Holme and Jennifer MacKellar, have just published a paper in *Nature Sustainability*, entitled “Systems thinking for education about the molecular basis of sustainability”. This discusses the potential roles and approaches that chemistry education can follow, introduces a new visualization tool, the systems-oriented concept map extension (SOCME) to for illustrating systems thinking in chemistry, and serves as a precursor to a series of papers that will be published in a Special Themed Issue of the *Journal of Chemical Education* around the end of 2019.

- The *Nature Sustainability* article can be read [here](#).
- A *Nature Sustainability* blog on the background to the article, by lead author Peter Mahaffy, can be read [here](#).

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