



I O C D

International Organization
for Chemical Sciences
in Development

*A group promoting
the chemical sciences
for sustainable development*



Chemists
for
Sustainability

Sustainable development is one of the overarching global challenges of the 21st century. In 2015, governments agreed at the United Nations on a set of 17 Sustainable Development Goals (SDGs) to be achieved by 2030

Chemists for Sustainability (C4S) was formed in 2014 by an international group of chemists who believe that ***chemistry and related sciences have indispensable roles to play in helping the world to achieve the SDGs.***

C4S has built upon earlier work and writings by IOCD members and has served advocacy and think-tank roles through written articles, lectures at various fora and web materials. It holds brainstorming meets about twice a year alternately in India and Europe, interacting in between by teleconference and email, to maintain a high momentum and deliver topical products via diverse international platforms. There are currently four core members in the group (from Africa, Asia and Europe), while collaborations are established with others (e.g. from Canada, China, Ethiopia and USA) to bring additional expertise and perspectives to the work. **C4S has recognised that chemistry itself must undergo deep-seated reforms in its vision, scope and conduct in order to achieve its goals.** The following is an overview of **C4S** products.

Repositioning chemistry for the 21st century

The **C4S** group argues that chemistry as a discipline needs redesign and reform, in order to ensure that it is attractive and productive as a science and relevant to solving 21st century challenges.

- S.A. Matlin, G. Mehta, H. Hopf. [Chemistry embraced by all](#). *Science*, 2015, **347**, 1179.
- S.A. Matlin, G. Mehta, H. Hopf, A. Krief. [Repositioning chemistry for the 21st century](#). *Atlas of Science*, 27 Jan 2016.

Chemistry for sustainable development

The **C4S** group discusses how chemistry's contributions are vital to help achieve sustainable development and the SDGs.

- S. A. Matlin, G. Mehta, H. Hopf, A. Krief. [The role of chemistry in inventing a sustainable future](#). *Nature Chem* 2015, **7**, 941-943.
- H. Hopf, A. Krief, S. A. Matlin, G. Mehta. [Die globale Verantwortung der Chemie](#). *Nachrichten aus der Chemie*, 2016, **64**, 547-548.

'One-world' chemistry and systems thinking

The concept of '**one-world chemistry**' (OWC) is presented by the **C4S** group 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.**

- S. A. Matlin, G. Mehta, H. Hopf, A. Krief. ['One-world' chemistry and systems thinking](#). *Nature Chem* 2016, **8**, 393-6.
- **Website:** 'One-world' chemistry. www.oneworldchemistry.org
- H. Hopf, S.A. Matlin, A. Krief, G. Mehta. [Chemie für die eine Welt](#). *Nachrichten aus der Chemie* 2016, **64**, 1190-1191.
- H. Hopf, S.A. Matlin, A. Krief, G. Mehta. [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.
- H. Hopf, G. Mehta, A. Krief, S.A. Matlin. [One-world chemistry and the quest for global sustainability](#). *Chem. Soc. Japan: Chemistry and Chemical Industry*, 2017, **10**, 873-875 ([English](#)); 876-878 ([Japanese](#)).

Systems thinking in chemistry education

The reforms in chemistry, including the OWC approach, advocated by the **C4S** group call for the **adoption of systems thinking by chemistry**. In collaboration with **Peter Mahaffy** (The Kings University, Edmonton, Canada), the group sets out the case for chemistry education to adopt systems thinking and points to pathways through which this can be achieved.

- S. A. Matlin, P.G. Mahaffy. [One-World Chemistry: Implications for Education](#). **International Organization for Chemical Sciences in Development**, September 2017, 6pp.
- P. G. Mahaffy, A. Krief, H. Hopf, G. Mehta, S. A. Matlin. [Reorienting chemistry education through systems thinking](#). 2017, **Nature Chemistry Reviews**, 2018, 2, 1-3; doi:10.1038/s41570.018.0126.
- P. G. Mahaffy, S. A. Matlin. [Learning Objectives and Strategies for Infusing Systems Thinking into \(Post\)-Secondary General Chemistry Education](#). **IUPAC** Project No. 2017-010-1-050, 2017-2019.
- P. G. Mahaffy, S. A. Matlin, T. Holme, J. MacKellar. [Teaching about the molecular basis of sustainability: the role of systems thinking](#). **Austral J Chem Ed** 2018, in preparation.
- T. Holme, J. MacKellar, P. G. Mahaffy, S. A. Matlin. [A systems thinking framework for educating about the molecular basis of sustainability](#). 2018, in preparation.

Reforming the role of chemistry organizations

Chemistry organizations should play **a leading, pro-active role in the repositioning of chemistry** that is required in the 21st century. The **C4S** group argues that this **necessitates reforms in both national (e.g. chemistry societies) and international (e.g. IUPAC) bodies that represent the interests of the discipline and the profession**.

- G. Mehta, A. Krief, H. Hopf, S. A. Matlin. [Chemical societies must adapt – here’s how to do it](#). **Chemistry World** 2016.
- S. A. Matlin, A. Krief, H. Hopf, G. Mehta. [Chemistry organizations in a changing world](#). **Chemistry International** 2017, **39**, 15-19.

Championing chemistry; advancing science

The **C4S** group discusses the **need for new champions of chemistry to step forward** to help drive the reforms that are required in the discipline.

- S. A. Matlin, G. Mehta, H. Hopf, A. Krief. [Championing chemistry](#). **Chem & Eng News** 2017, **95(6)**, 20-21.

In the ‘post-truth’ era, the **C4S** group emphasises the importance of chemists and other scientists **vigorously promoting ‘scientific temper’** (the adoption of the culture of science, in and beyond the field itself, as a way of life that rejects anti-science thinking).

- S. A. Matlin, H. Hopf, A. Krief G. Mehta. [Why Scientists Are Marching](#). Posted online by **Project Syndicate** 17 April 2017: this article was syndicated in newspapers around the world.
- A. Krief, H. Hopf, G. Mehta, S. A. Matlin. [Science in the post-truth era](#). **Current Science** 2017, **112**, 2173-2174.
- H. Hopf, A. Krief, G. Mehta, S.A. Matlin. [Die Welt des Postfaktischen - ein Widerwort aus der Wissenschaft. Nachrichten aus der Chemie](#). 2017, **65**, 659-661.

Chemistry has made central contributions to **improving health, wellbeing and life expectancy** – but even more is needed now. The **C4S** group identifies a number of **disconnections that are preventing the optimal contributions** that can be made and suggests systemic approaches to developing solutions.

- S. A. Matlin, G. Mehta, A. Krief, H. Hopf. [The chemical sciences and health: strengthening synergies at a vital interface](#). **ACS Omega**, 2017, 6819-6821.

The **C4S** group analyses the **system of scientific publishing**, with emphasis on a perspective from the chemical sciences, and identifies a **deep crisis** that is unfolding, driven by the conjunction of sub-systems that connect the primary purpose of scientific advancement with financial and reputational rewards. It argues that piecemeal solutions are unlikely to be effective or sustainable and **the time is ripe for the stakeholders in science publishing to seek new, systemic approaches that comprehensively address the fundamental flaws**. The outlines of an action plan for the science community to generate such a process are suggested.

- S. A. Matlin, G. Mehta, A. Krief, H. Hopf. [The scientific publishing conundrum: a perspective from chemistry](#). **Beilstein Magazine** 2017, 3, No. 9, doi:10.3762/bmag.9.

Promoting the chemical sciences and IOCD's role

A review written for the 2011 International Year of Chemistry by IOCD scientists Stephen Matlin and **Berhanu Abegaz** (Ethiopia) highlights achievements of the chemical sciences during more than two centuries of advancing knowledge and creating useful processes and products. The **C4S** group presents insights from notable chemists of the past, which have stood the test of time and resonate with contemporary contexts beyond the science discipline itself; and overviews the work of C4S to promote IOCD and its role. The group reflects on the significance of the International Year of the Periodic Table of the Chemical Elements

- S.A. Matlin, B.M. Abegaz, [Chemistry for development](#). In: J. Garcia-Martinez, E. Serrano-Torregrosa (eds), **The Chemical Element: Chemistry's Contribution to Our Global Future**, Wiley-VCH, Weinheim, 2011, Chapter 1, 1-70.
- G. Mehta, A. Krief, H. Hopf, S. A. Matlin. [Living messages from chemistry icons: Legacies with contemporary relevance](#). 2018, submitted.
- A. Krief, H. Hopf, G. Mehta, S. A. Matlin. *Repositionnement des sciences chimiques en vue de créer un avenir durable*. **Chimie Nouvelle** 2018, in the press.
- S. A. Matlin, H. Hopf, G. Mehta, A. Krief. *Repositioning the chemical sciences for a sustainable future*. **Chimie Nouvelle** 2018, in the press.
- H. Hopf, A. Krief, G. Mehta, S. A. Matlin. *The chemical sciences and sustainability*. (In German). **Nachrichten aus der Chemie** 2018, accepted.
- S. A. Matlin, H. Hopf, A. Krief, G. Mehta. [The simple matter of sustainability](#). 2018, submitted.

The chemical sciences and equality, diversity and inclusion

In collaboration with **Vivian Yam** (Hong Kong University, China), the **C4S** group discusses the **challenge of dealing with conscious or unconscious forms of bias and discrimination in the sciences** and argues that the chemical sciences can play a leading role in addressing biases, through (1) becoming a **model of good systemic practice** in policies, processes and actions; (2) developing **practical skills through training in cultural competence**; and (3) promoting a **stronger evidence base**, to uncover both the extent of problems and the degree to which approaches to improve equality, diversity and inclusion are working.

- S. A. Matlin, V. W. W. Yam, H. Hopf, A. Krief, G. Mehta. [Tackling Science's Gender-Parity Problem](#). Posted online by **Project Syndicate**, 9 February 2018: this article was syndicated in newspapers around the world.
- G. Mehta, V. W. W. Yam, A. Krief, H. Hopf, S.A. Matlin. [The chemical sciences and equality, diversity and inclusion](#). **Angew Chem Internat Edn** 2018, in the press.

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