EDUCATION AND ENGAGEMENT:
Promoting a Culture of Responsible Chemistry

FINAL REPORT OF THE SCIENTIFIC ADVISORY BOARD'S TEMPORARY WORKING GROUP

NOVEMBER 2014

ORGANISATION FOR THE PROHIBITION
OF CHEMICAL WEAPONS

The **Organisation for the Prohibition of Chemical Weapons** is the implementing body of the Chemical Weapons Convention (CWC), which entered into force in 1997. As of today, the OPCW has 190 Member States, who are working together to achieve a world free of chemical weapons.

The **Scientific Advisory Board** (SAB) is a subsidiary body of the OPCW established in accordance with the CWC to enable the Director-General to render specialised advice in science and technology to OPCW Member States. For more information on the SAB and to download other SAB reports, please visit http://www.opcw.org/about-opcw/subsidiary-bodies/scientific-advisory-board/.

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EDUCATION AND ENGAGEMENT:
Promoting a Culture of Responsible Chemistry

FINAL REPORT OF THE TEMPORARY WORKING GROUP ON EDUCATION AND OUTREACH IN SCIENCE AND TECHNOLOGY RELEVANT TO THE CHEMICAL WEAPONS CONVENTION

NOVEMBER 2014

Adopted by the Scientific Advisory Board on 25 November 2014.
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Organisation for the Prohibition of Chemical Weapons

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Executive Summary

Education and outreach in science and technology relevant to the Chemical Weapons Convention is essential for the Convention's future implementation, particularly in terms of preventing the re-emergence of chemical weapons.

At its Seventeenth Session, the Scientific Advisory Board (SAB) recommended that a temporary working group (TWG) on Education and Outreach on Science and Technology Relevant to the Convention be established.[1] The Director-General endorsed this recommendation and, in accordance with paragraph 9 of the Terms of Reference of the SAB,[2] established the working group and appointed Professor Djafer Benachour as the Chair of the group.

The TWG met four times at OPCW Headquarters in The Hague. In addition to its formal meetings, much work was carried out intersessionally in the form of projects facilitated, or directly led, by TWG members. Individual TWG members also worked to formalise and strengthen collaborations and partnerships with other organizations, such as the International Union of Pure and Applied Chemistry (IUPAC).

Meeting	Dates	Report
First	12 – 13 April 2012	Annex 2 to SAB-18/1, dated 19 April 2012[3]
Second	22 to 24 November 2012	SAB-20/WP.1, dated 25 February 2013[4]
Third	26 to 29 November 2013	SAB-21/WP.3, dated 7 January 2014[5]
Fourth	24-25 September 2014	[no meeting report issued, all discussions incorporated into this final report]

This report has been produced in accordance with Rule 6.2 of the SAB's rules of procedure, which require each temporary working group to provide a report to the Chair of the Scientific Advisory Board, with a copy to the Director-General, on the results of its research into and analysis of the issue in question.

While education and outreach has been a concern of the OPCW for many years as described in Chapter I, the past two years have seen a significant paradigm shift in the way in which education and outreach is viewed and how it is approached. Traditionally, education and outreach had been seen primarily in terms of sensitising relevant audiences to the prohibitions and obligations of the CWC and raising awareness about the role and activities of the OPCW. While such an approach is clearly appropriate, for reasons laid out in Chapter II of this report the OPCW and its Member States are now adopting a more expansive understanding of education and outreach. In this new conceptualisation, education and outreach is seen as an integral component of efforts to prevent the re-emergence of chemical weapons, which will be one of the key tasks of the OPCW in future years. In this situation, education and outreach is a core component of national implementation of the Convention. Engagement with stakeholders in the chemical industry, the scientific community, academia and the public at large contributes to promoting and expanding a culture of responsible science.

1 Subparagraph 16.6 of SAB-17/1, dated 23 November 2011, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=15239.

2 The Terms of Reference of the SAB are available at http://www.opcw.org/fileadmin/OPCW/SAB/en/SAB_ToR_RoP.pdf.

3 Available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=15412.

4 Available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=16195.

5 Available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=17057.

Education and outreach serves a number of specific purposes including, inter alia:

A. Raising awareness of the Convention among the broad community of relevant professionals who should be aware of the Convention, including students, educators, the global scientific community and the chemical industry;

B. Stressing the potential risks posed by the multiple uses of chemicals;

C. Contributing to national implementation of the Convention;

D. Contributing to the prevention of the misuse of toxic chemicals;

E. Facilitating chemical safety and chemical security;

F. Building skills and capabilities in areas relating to the peaceful uses of chemistry; and

G. Educating future generations of the societal benefits of upholding a world free of chemical weapons and the need to prevent their re-emergence.

Recommendations

Based on the findings and activities of the TWG as described in Chapter III, this report contains seven recommendations regarding the sustainability of OPCW education and outreach efforts for the consideration of the SAB, the Director-General and the States Parties. These recommendations appear in full in Chapter IV, but are also summarised here:

1. Education and outreach with respect to the responsible use of science, particularly as it is relevant to the Chemical Weapons Convention, should remain a core activity of the OPCW, so as to achieve and maintain a world free of chemical weapons;

2. The OPCW's education and outreach activities with respect to the responsible use of science, particularly as it is relevant to the CWC, should be guided by evidence-based science education and communication practices;

3. An ongoing expert advisory group on education and outreach with respect to the responsible use of science, particularly as it is relevant to the CWC, should be established to help OPCW fulfil its mandate for education and outreach;

4. The core mandate for the expert advisory group should be:

    a. To advise the Director-General on matters related to education and outreach, which are embedded in each of the core activities of OPCW;

    b. To advise and support the education and outreach work carried out by OPCW staff members, National Authorities and States Parties, and activities at regional and national levels;

    c. To maintain a portfolio of education and outreach activities and projects, to validate material that has been developed and to advise on how to make it accessible to target audiences;

    d. To monitor global education and outreach activities related to responsible uses of science, particularly as relevant to the CWC; and

e. To develop informal and formal partnerships with international organizations and other stakeholders working in areas related to OPCW's education and outreach mandate.

5. In the appointment of the expert advisory group with respect to the responsible use of science, particularly as it is relevant to the CWC, individuals with expertise in areas such as the following should be included: science education (particularly chemistry), disarmament and non-proliferation education, science communication, chemical industry and dual/multiple use issues related to chemistry and the biological sciences;

6. The expert advisory group will develop its own education and outreach strategies, short and long term priority target audiences, informal and formal collaborations and partnerships and activities and materials; and

7. Until such time as the expert advisory group is appointed, the current TWG should continue its work.

Chapter IV also contains six additional recommendations for consideration by the SAB, the Director-General and the States Parties, which are summarised here:

8. Chemical weapons issues are best introduced in formal education contexts through the "Multiple Uses" approach, so as to emphasize that most chemicals are beneficial;

9. To enhance the impact of the work on education and outreach the Technical Secretariat and National Authorities should reach out to national ministries of education and to the scientific networks of national academies at the regional and global level;

10. The OPCW should work with IUPAC's Committee on Chemistry Education to develop one or more joint projects that use the problem of chemical weapons as rich contexts to introduce topics for education at different levels;

11. Accurate information about chemical weapon related issues, including precursors, destruction, decontamination and detection of chemical warfare agents should be provided by the OPCW, as the organization that has most of the information and that is seen as the most credible source of information on issues associated with chemical disarmament and the non-re-emergence of chemical weapons. This information could include physical protective measures and medical countermeasures;

12. For the centenary activities surrounding the commemoration of the first large scale use of chemical weapons in the First World War, the OPCW should develop, in partnership with schools, perhaps starting with schools in the Ieper area, an educational project on the history of the use of chemical weapons and the CWC; and

In the event that the recommendations for the appointment of an ongoing expert advisory group are approved, but cannot be implemented soon enough to avoid a loss of momentum in activities, a meeting of the TWG should be held in 2015.

Objectives of the Temporary Working Group

In accordance with the Rules of Procedure of the SAB,[1] the Director-General transmitted to Professor Djafer Benachour as Chair of the TWG Terms of Reference setting out the specific issues to be addressed and the time limit within which the group should report on the issue. With respect to the latter, the Terms of Reference stated that the group would exist for three years from the date of its first meeting, at which time its work would be reviewed by the SAB and the Director-General and a decision made as to whether it should continue its work and whether the Terms of Reference should be revised.

The Terms of Reference defined the objective of the TWG as building on earlier work in this area by the SAB and its members, utilising the experience of other initiatives in this field and related areas, and making recommendations to the SAB for sustainable activities which could be pursued by the OPCW and its Member States.

The composition of the TWG's membership was also outlined in the Terms of Reference. They stated that the group should consist of individuals with expertise in: the state of play of education and outreach in science and technology relevant to the Convention; potential developments in science and technology relevant to the Convention; state-of-the-art tools and techniques for education and outreach; public and media affairs; science and technology research and education policy; and perspectives from the chemical industry. Qualified members of the SAB were also expected to join the group. Furthermore, the Terms of Reference stated that representatives of relevant international organisations, professional associations and scientific unions may also be invited to join the group. A list of the TWG members is provided in Annex 1.

The members of the Temporary Working Group on Education and Outreach (Stefan Mogl was not present at this meeting)

1 See Rule 1.7 of the Rules of Procedure for the Scientific Advisory Board and Temporary Working Groups of Scientific Experts, Annex to EC-XIII/DG.2, dated 20 October 1998, available at http://www.opcw.org/fileadmin/OPCW/SAB/en/SAB_ToR_RoP.pdf.

In its Terms of Reference, the group was requested to report to the SAB on the following:

1. Ways to raise awareness of the Convention in the education sector, in particular through:

    a. The development of teaching materials;

    b. Promoting faculty development and student exchange;

    c. Promoting the inclusion of the Convention in educational curricula.

2. Proposals for how the OPCW could further develop its relationships with the scientific community and the chemical industry with a view to raising awareness of the requirements of the Convention and promoting universal adherence to it;

3. Proposals for how the OPCW could contribute towards expanding and promoting a culture of responsibility in the scientific community and the chemical industry;

4. Existing initiatives in this area with a view to avoiding duplication and allowing the OPCW to build relationships with other international organisations, professional associations, networks etc; and

5. Sustainable ways in which the OPCW can take forward its education and outreach activities once the TWG completes its work.

The Terms of Reference further stated that the TWG should also, when necessary, draw upon the expertise of external guest speakers and upon the Technical Secretariat. A list of guest speakers, who volunteered their time to help the TWG, is provided in Annex 2.

I. Education and Outreach in the OPCW 1997-2012

Education and outreach has been a concern of the OPCW since its early years. The "Ethics Project" was launched in 2001, and aimed at increasing awareness of the OPCW and its objectives, first and foremost amongst the professions directly affected by the regime of chemical disarmament and non-proliferation established by the Convention, including chemists, chemical engineers and life scientists, as well as students receiving higher education in these areas. The Ethics Project was based on the proposition that the implementation of the Convention is not just a legal and administrative matter, but also involves promoting awareness of the Convention, generating support amongst the general public for the principles of chemical disarmament and non-proliferation established by it, including the professional communities in chemistry and chemical engineering.[1]

Education and outreach entered the agenda of the Scientific Advisory Board (SAB) in 2002 when the SAB turned its attention to preparing its report to the first of the five-yearly review conferences of the Chemical Weapons Convention. At its fifth session, held in September 2002, the SAB discussed "issues related to science education, outreach, and cooperation" and decided to return to them at its next session. The SAB received substantive input and encouragement on education and outreach from the International Union of Pure and Applied Chemistry (IUPAC), which partners with the OPCW to assess the impact of scientific and technological developments on the Convention prior to each review conference.[2]

The OPCW and IUPAC organised an international workshop in Bergen, Norway from 30 June to 3 July 2002 to assess the impact of scientific and technological developments on the Convention. At the workshop, all discussion groups independently reached the conclusion that greater efforts should be made in education and outreach to various audiences, ranging from the States Parties and their National Authorities to non-States Parties and to the worldwide scientific community. Furthermore, the conference report states that "In due course, chemical weapon prohibition and non-proliferation considerations may even be incorporated into university and school curricula as part of chemistry education in a similar way to that in which environmental issues, ethics of genetics, and similar issues have been incorporated into chemistry and biology education in the recent past".[3]

In its own report to the First CWC Review Conference, the SAB echoed the recommendations from the Bergen workshop, stating, "Greater efforts in terms of education and outreach to the worldwide scientific and technical community are needed in order to increase awareness of the Convention and its benefits".[4] The SAB's report continued:

"The SAB was convinced that efforts in the area of education and outreach are important to further the objectives of the Convention; these efforts include raising awareness, assuring that the principles of the Convention become firmly anchored in professional ethics and teaching, and promoting international cooperation in the field of chemistry".

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1 OPCW document, RC-1/S/3, dated 23 April 2003, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=16222.

2 For more on the establishment of this partnership, see Leiv Sydnes, "IUPAC, OPCW and the Chemical Weapons Convention", *Chemistry International*, Vol. 35, No. 4 (July-August 2013), pp. 4-8, available at http://www.degruyter.com/view/j/ci.2013.35.issue-4/ci.2013.35.4.4/ci.2013.35.4.4.xml.

3 George W. Parshall, Graham S. Pearson, Thomas D. Inch, and Edwin D. Becker, "Impact of Scientific Developments on the Chemical Weapons Convention (IUPAC Technical Report)", *Pure and Applied Chemistry*, Vol. 74, No. 12 (2002), pp. 2323–2352, available at http://www.iupac.org/publications/pac/pdf/2002/pdf/7412x2323.pdf.

4 OPCW document, RC-1/DG.2, dated 23 April 2003, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=4864.

The SAB added that it would "need to continue discussing practical and useful measures in relation to education, outreach, and international cooperation as part of its future work programme". It also pointed out that the OPCW should continue and intensify its dialogue with international scientific unions such as IUPAC.

The report of the First Review Conference, whilst not explicitly addressing education and outreach, included the following conclusion:

> "The First Review Conference noted that a valuable aspect of national implementation measures involves ensuring that the chemical industry, the scientific and technological communities, the armed forces of the States Parties, and the public at large are aware of and knowledgeable about the prohibitions and requirements of the Convention".[5]

In addition, the First Review Conference "encouraged States Parties to take measures to raise awareness about the prohibitions and requirements of the Convention, inter alia in their armed forces, in industry, and in their scientific and technological communities".[6]

At its sixth session in February 2004, the SAB recommended that, "as a first step, the OPCW formally approach the IUPAC with a request for help in developing and implementing a project to enhance awareness of the Convention and to incorporate aspects of the Convention and its implementation into science curricula".[7] A proposal for a joint project on chemistry education, outreach, and the professional conduct of chemists was therefore agreed between the Director-General of the OPCW and the President of IUPAC.[8] Significantly, at this session the SAB also recommended that "the Director-General establish a temporary working group on education and outreach, which would discuss further the contribution that the SAB might make to enhancing awareness of the Convention".

The joint project was discussed by representatives of the OPCW, the SAB and IUPAC at a meeting in The Hague in January 2005. This meeting agreed the project outline and decided to take it forward through a joint OPCW and IUPAC workshop entitled "The Chemical Weapons Convention, Chemistry Education and the Professional Conduct of Chemists". At its seventh session in February 2005, the SAB encouraged the planning of the workshop, "on the understanding that over the long term it would lead, inter alia, to awareness-raising, efforts to provide educational materials and guidance to school and university science teachers, and the incorporation of the Convention's requirements into codes of conduct and ethics for scientists and engineers". The workshop took place in Oxford, UK in July 2005 with financial support from the OPCW and IUPAC.[9]

The workshop came to a number of conclusions and made several recommendations. Two such recommendations were (i) the need for chemists to develop their own codes of conduct, and (ii) the development of educational material which describes the CWC and the obligations it places on its member states. Following the workshop, the OPCW and IUPAC therefore established two new projects.[10] It was felt important to place the CWC in the context of the beneficial uses and misuses of chemicals and raise awareness of multiple uses of the same substances.

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5 Ibid.

6 Ibid.

7 SAB-6/1, para. 7.2, dated 18 February 2004.

8 IUPAC project, "A joint OPCW - IUPAC project on education and outreach regarding chemical weapons", http://www.iupac.org/nc/home/projects/project-db/project-details.html?tx_wfqbe_pi1%5bproject_nr%5d=2004-048-1-020.

9 Graham S. Pearson, and Peter Mahaffy, "Education, outreach, and codes of conduct to further the norms and obligations of the Chemical Weapons Convention (IUPAC technical report)", *Pure and Applied Chemistry*, Vol. 78, No. 11 (2006), pp. 2169-2192, available at http://www.iupac.org/publications/pac/pdf/2006/pdf/7811x2169.pdf.

10 IUPAC project, "Educational material for raising awareness of the Chemical Weapons Convention and the multiple uses of chemicals", http://www.iupac.org/nc/home/projects/project-db/project-details.html?tx_wfqbe_pi1%5bproject_nr%5d=2005-029-1-050; IUPAC project, "Multiple use of chemicals and professional code of conduct", http://www.iupac.org/nc/home/projects/project-db/project-details.html?tx_wfqbe_pi1%5bproject_nr%5d=2005-028-1-050.

At its eighth session in February 2006, the SAB received a progress report from the leader of the project to develop educational materials. At its meeting, members of the SAB recognised that they had "an individual and collective responsibility to promote an awareness and an understanding of the requirements of the Convention among the entire scientific community (not only students, chemists and chemical engineers but, more broadly, scientists active in the life sciences) and the public".[11] The SAB also affirmed the importance of involving National Authorities in education and outreach activities. Also at its eighth session, the SAB recommended that the OPCW again approach IUPAC with a proposal for an international symposium that would take place early in 2007 that would review the impact of developments in science and technology on the Convention.[12] In his response to the SAB's report, the Director-General shared the SAB's view that National Authorities were important partners in communicating with those responsible for the development of educational curricula. The Director-General's response also stated that educational curricula should provide not only information but also ethical guidance to teachers and students.[13] In September 2006, the SAB and IUPAC convened a joint seminar in Bologna, Italy to establish general ethical principles and a code of conduct for the scientific community dealing with chemistry. The development of a code of ethics was discussed to ensure that university and post-graduate curricula in chemistry include education in the ethical norms that govern the peaceful uses of chemistry.

At its ninth and tenth sessions held in February and May 2007 respectively, the SAB received further briefings on the two projects described above and expressed its support for them. At its tenth session, the SAB noted that the temporary working group on education and outreach proposed at its sixth session had never actually met. There were divergent views on when the group should be established but most members of the SAB agreed that the results achieved so far should be used in the structuring of the terms of reference for the temporary working group. They also agreed that these draft terms of reference should address the practical implementing procedures regarding education, awareness-raising and outreach. The SAB decided to further consider its decision on this matter.

As recommended by the SAB's eighth session and as had happened before the First CWC Review Conference, the OPCW again partnered with IUPAC to organise another workshop to assess the impact of scientific and technological developments on the Convention. This meeting took place in Zagreb, Croatia in April 2007 and once again, awareness-raising, education and outreach figured prominently on the workshop agenda. The workshop report noted that:

> "Awareness in the scientific and technological communities in all countries about the CWC and its norms, prohibitions, and implementation requirements remains poor. This calls for increased outreach by States Parties and the OPCW; at the same time, it also proves the need for further efforts to incorporate ethical norms and knowledge about the CWC and the dual-use nature of advances in science and technology into chemistry education".[14]

The report went on to say that States Parties and the OPCW should continue to reach out to the scientific community, promote the adoption of codes of conduct and maintain a dialogue with the scientific community and civil society. Furthermore, it added that "The requirements and norms of the CWC should become a regular part, at an early stage, of the education of every student of chemistry and chemical engineering".

At its eleventh session in February 2008, the SAB noted the "significant progress" that had been made in the area of education and outreach, particularly in conjunction with other organisations. As a result, the predominant view of the SAB was that "education and outreach has now progressed beyond the stage where

11 SAB-8/1, dated 10 February 2006, para. 7.3.

12 Ibid, para 8.2.

13 EC-44/DG.7, dated 8 March 2006.

14 Mahdi Balali-Mood, Pieter S. Steyn, Leiv K. Sydnes and Ralf Trapp, "Impact of scientific developments on the Chemical Weapons Convention", *Pure and Applied Chemistry*, Vol. 80, No. 1 (2008), pp. 175–200, available at http://media.iupac.org/publications/pac/2008/pdf/8001x0175.pdf.

a TWG would accelerate the progress being made". As an alternative to a TWG, the SAB proposed that the International Cooperation and Assistance Division, in cooperation with IUPAC and with continued support from the SAB, should be asked to take the lead for future activities in this area.[15] In his response to the SAB's report, the Director-General tasked the Division to explore the possibility of taking the lead for such future activities, in cooperation with IUPAC's Committee on Chemistry Education.[16]

In its report to the Second Review Conference in April 2008, the SAB recalled the progress made since the First Review Conference, in collaboration with IUPAC, in raising awareness in the chemical profession about the Convention.[17] In his response to the SAB's report, the Director-General expressed his view that "further collaboration between the OPCW and the scientific and chemical industry communities is important for the effective implementation of the Convention". In this context, the Director-General stated that "the adoption of professional codes of conduct and other governance measures can help promote compliance with the requirements of the Convention by all professionals and institutions that deal with chemicals".[18] Like the report of the First Review Conference, that of the Second Review Conference did not make specific reference to education and outreach, instead referring to raising awareness about the prohibitions and obligations of the Convention. However, reflecting the work which had taken place on codes of conduct in the intervening years, the Conference did note that "voluntary measures by relevant industry and scientific communities to promote responsible conduct can also help to guard against chemical weapons, as defined in the Convention, being used".[19]

Following the Second Review Conference, the SAB met for its twelfth session in November 2008. At this session, the SAB was briefed on relevant programmes by the International Cooperation and Assistance Division, which had assumed the lead for future activities in the area of education and outreach. Thereafter, education and outreach does not appear on the agenda of the SAB again until its sixteenth session in April 2011.

Renewed consideration of education and outreach by the SAB was stimulated by the OPCW's new Director-General, Ahmet Üzümcü, who took office in July 2010, after having referred to education and public diplomacy in his presentation as a candidate for the position of Director-General. In August 2010, the Director-General wrote to the Chairperson of the SAB requesting the advice of the SAB on "how to enhance outreach activities of the OPCW to the scientific community". At the sixteenth session of the SAB, the members recalled previous activities, particularly the joint projects with IUPAC, and also outlined various individual education and outreach activities and programmes. Others however, mentioned that their efforts to provide presentations and courses related to enhancing education about and awareness of the Convention had not materialised.[20]

At its seventeenth session in November 2011, the SAB conducted a roundtable with the Director-General on the scientific and technological aspects of the future priorities of the OPCW. The stimulus for this discussion was the report by the Advisory Panel on Future OPCW Priorities which the Director-General had established in 2010.[21] During the discussion, in the context of prevention, the Director-General referred to the need, through education and outreach, to raise awareness among the academic community and industry of the dual-use risks associated with toxic chemicals. To this end, he expected the SAB to provide important inputs. Among the issues raised by SAB members in response were ethical rules and codes of conduct for chemists and ways to improve the public perception of chemistry through public diplomacy. In order to take these suggestions forward, the SAB recommended the establishment of a temporary working group on education

15 SAB-11/1, dated 13 February 2008, para. 8.11.

16 EC-52/DG.11, dated 27 February 2008.

17 RC-2/DG.1, dated 28 February 2008, Annex, paras 7.1 – 7.2, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=1871.

18 Ibid, para. 7.2.

19 RC-2/4, dated 18 April 2008, para 9.77, available at http://www.opcw.org/index.php?eID=dam_frontend_push&docID=1837.

20 SAB-16/1, dated 6 April 2011, para. 16.3, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=14976.

21 S/951/2011, dated 25 July 2011, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=15031.

and outreach in science and technology relevant to the Convention and proposed that the group be chaired by SAB member Djafer Benachour from Algeria.[22]

In his response to the SAB's report, the Director-General endorsed the establishment of the temporary working group and encouraged it to build upon previous relevant activities, including by the SAB itself and its members, and to take account of education and outreach initiatives in other fields, e.g. in the life sciences and nuclear security. The Director-General also recalled that, while the temporary working group should focus on education and outreach relating to chemistry, "the education and outreach activities of the OPCW are not limited only to chemistry, and the group's efforts should be seen in this context".[23] Additional input to the group came from the third OPCW-IUPAC workshop on developments in science and technology relevant to the Chemical Weapons Convention which took place in Spiez in Switzerland in February 2012. Like its predecessor meetings in Bergen and Zagreb, this meeting also paid attention to education and outreach:

> "In addition to any changes in more formal regulations, the future success of the CWC will thus depend on promoting awareness of the Convention and its requirements among a wider audience. This will support improved implementation at the national level and, by engaging the scientific community, will help ensure that its members do not inadvertently contribute to proliferation or other hostile purposes such as chemical terrorism".[24]

The temporary working group convened in The Hague for its first meeting in April 2012 and its activities and recommendations are described in detail in the following chapters of this report.

Members of the Temporary Working Group on Education and Outreach at its first meeting in April 2012

22 SAB-17/1, dated 23 November 2011, para. 16.6, available at http://www.opcw.org/index.php?eID=dam_frontend_push&docID=15239.

23 EC-67/DG.11, dated 9 February 2012, para. 24.

24 Katie Smallwood, Ralf Trapp, Robert Mathews, Beat Schmidt, and Leiv K. Sydnes, "Impact of scientific developments on the Chemical Weapons Convention (IUPAC Technical Report)", *Pure and Applied Chemistry*, Vol. 85, No. 4 (February 2013), pp. 851-881, available at http://www.degruyter.com/view/j/pac.2013.85.issue-4/pac-rep-12-11-18/pac-rep-12-11-18.xml.

II. Developing a New Approach to Education and Outreach

While education and outreach has been a concern of the OPCW for many years as described in Chapter I, the past two years have seen a significant paradigm shift in the way in which education and outreach is viewed and how it is approached. This chapter outlines the TWG's analysis of the reasons for this shift by focusing first on factors internal to the OPCW, then on new external concepts and frameworks within stakeholder communities, then on related developments in other disarmament and non-proliferation fields, next by studying recent new educational tools and approaches, and finally by relating these trends and developments to events closer to the OPCW. For the reasons described here, the OPCW and its Member States are now adopting a more expansive understanding of education and outreach. In this new conceptualisation, education and outreach is seen as an integral component of efforts to prevent the re-emergence of chemical weapons, which will be the key task of the OPCW in future years.

Developments in the OPCW Environment

The OPCW in a Time of Transition

The OPCW is at a crucial time in its evolution. As of 31 October 2014, over 85% of the world's declared chemical weapons stockpiles have been destroyed. This means that, not long from now, the OPCW and its Member States will have achieved the complete destruction of existing stockpiles of declared chemical weapons. This significant achievement will have implications for the OPCW which, until now, has devoted most of its resources to verifying the destruction of these chemical weapons and the associated production facilities. To explore the effect that this would have on the OPCW, Director-General Ahmet Üzümcü established an Advisory Panel on Future OPCW Priorities in late 2010. The Panel, chaired by Ambassador Rolf Ekéus of Sweden, issued its report in July 2011 which stated that "the OPCW needs to prepare for a transition from mandates and efforts primarily characterised by the elimination of chemical weapons stockpiles and production facilities to an agency that will have as its main task to ensure that the menace of chemical warfare and the use of toxic chemicals for hostile purposes will never reappear, and that international cooperation and assistance in the field of peaceful uses of chemistry can flourish".[1]

In this "post-destruction phase", the achievements of the OPCW will be measured not just by weapons destroyed, but by the absence of production of new chemical weapons. Within the OPCW, this objective has been termed "preventing the re-emergence of chemical weapons". It is widely recognised that this is a very different, and potentially more complex challenge than destroying existing chemical weapons. Under Director-General Üzümcü, the OPCW is beginning the delicate task of recalibrating its priorities in order to face this new challenge. Addressing this in his opening remarks at the OPCW's "Education for Peace" conference in September 2014, Director-General Üzümcü said: "We now need to harness renewed interest in chemical disarmament and ensure that it outlives the headlines to focus on what must come next. This relates to the much harder, less publicly visible task of making sure chemical weapons never return".[2] In this respect, he went on to say: "It is my firm belief that education and outreach are crucial building blocks for establishing an effective and durable bulwark in this respect – ones to which we must keep adding".

Preventing the re-emergence of chemical weapons will require the OPCW to strengthen existing activities and programmes and also to seek out new partnerships, particularly with the scientific community, educational

1 S/951/2001, dated 25 July 2011, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=15031.

2 See https://www.opcw.org/index.php?eID=dam_frontend_push&docID=17628.

networks, and the chemical industry, as well as with civil society. The point made by former US Ambassador Charles Floweree in 1990 is still very relevant today: "The means by which these agreements survive and adapt to changing conditions after they enter into force deserve as much attention as the negotiations that produced them in the first place. They cannot simply be left to fend for themselves".[3]

The Third CWC Review Conference and Beyond

The Third CWC Review Conference in April 2013 was an important milestone in the evolution of the OPCW towards the "post-destruction phase". It was also significant because it was the first CWC review conference to make recommendations relating to education and outreach, demonstrating the increased salience of this issue to OPCW Member States.[4] In the political declaration, States Parties underlined their determination to "maintain the Convention's role as a bulwark against chemical weapons; to that end to promote, inter alia, outreach, capacity building, education and public diplomacy". During the general debate at the Review Conference, education and outreach was mentioned in over a quarter of all national statements.

United Nations Secretary-General Ban Ki-moon at the Third CWC Review Conference

In several parts of the main part of the report, the Third Review Conference acknowledged the importance of education and outreach. For example, the Conference "acknowledged the role of education, outreach and awareness-raising as a relevant activity for the national implementation of the Convention, including awareness among academia and relevant scientific communities of the provisions of the Convention, the domestic laws and regulations relevant to the Convention". Furthermore, the Conference "welcomed the establishment of the SAB temporary working group on education and outreach".[5] Several members of the TWG attended the Review Conference allowing them to interact with delegations and a panel discussion on science and technology included a session on education and outreach in which two TWG members participated.

3 Charles C. Floweree, "On Tending Arms Control Agreements", *The Washington Quarterly*, Winter 1990, pp. 199-214.

4 See Djafer Benachour and Daniel Feakes, "Education, outreach and awareness-raising after the Third Review Conference", *OPCW Today*, Vol. 2 No. 5 (2013), pp. 12-14, available at https://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_2_No_5.pdf.

5 Paragraph 9.101, available at http://www.opcw.org/index.php?eID=dam_frontend_push&docID=16406.

Building upon the recommendations of the TWG as transmitted to the Conference in the report of the SAB, the final report of the Third Review Conference included four recommendations that specifically address education, outreach and awareness-raising:

1. "Encouraged the Secretariat, in concert with the SAB temporary working group on education and outreach, to assist States Parties, upon request, in implementing education and outreach activities, including by disseminating materials, conducting workshops and regional meetings" (subparagraph 9.103(e))

2. "Encouraged the Secretariat to continue to develop relationships and partnerships with other relevant bodies, national and international, that are working to promote the peaceful and responsible use of chemistry, including capacity building" (subparagraph 9.131(j))

3. "Encouraged the Secretariat to continue to develop relations and partnerships as appropriate with relevant regional and international organisations, as well as chemical industry associations, the private sector, academia, and civil society, in order to raise awareness of the activities of the OPCW" (subparagraph 9.131(l))

4. "Called upon States Parties and the Secretariat, as part of efforts to promote the ethical norms of the Convention, to encourage and promote efforts by the appropriate national and international professional bodies to inculcate awareness amongst scientists and engineers at an early stage in their training that the knowledge and technologies used for beneficial purposes should only be used for purposes not prohibited under this Convention" (subparagraph 9.155(d))

The endorsement of ongoing education and outreach activities, and the recommendations for additional efforts, are landmarks in the attention paid to this issue within the OPCW. As will be shown elsewhere in this report, OPCW programmes, events and activities have been modified or expanded upon in response to these recommendations. A significant development was the inclusion, at the request of the delegation of Argentina, of an agenda item on education and outreach at the Seventy-Sixth Session of the Executive Council in July 2014. Under this agenda item, Argentina presented a national paper and the Secretariat submitted a Note.[6] This marked a significant milestone, being the first time that education and outreach had appeared as an item in the agenda of the Executive Council. In the report of the session, the Council encouraged the Secretariat to continue implementing the appropriate recommendations of the Third Review Conference regarding education and outreach and also the recommendations reached at the regional meeting on education and outreach held in Buenos Aires. The Council also agreed, "due to the importance of education and outreach", to consider having regular discussions of the item at future sessions.

At its Seventy-Sixth Session, the Council also highlighted the importance of having sufficient funding for these activities in the regular OPCW budget. Most of the projects and activities undertaken by the OPCW before 2014 and described elsewhere in this report had been funded by voluntary contributions from supportive States Parties. However, again reflecting the heightened attention awarded to education and outreach during and after the Third Review Conference, for the first time in the OPCW's existence the 2014 OPCW programme and budget includes funding for education and outreach activities. The draft programme and budget for 2015, which is due to be adopted in December 2014, includes an even larger appropriation for education and outreach activities.

Education and outreach is now becoming an accepted activity of the OPCW, supported by its Member States and reflected in its key strategic documents, such as the outcome document of the Third Review Conference and the Medium-Term Plan for the period from 2015 to 2019.[7] Whereas education and outreach was earlier

6 See EC-76/NAT.1, dated 5 June 2014, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=17492 and EC-76/S/4, dated 1 July 2014, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=17445 respectively.

7 See EC-77/S/1, dated 23 April 2014, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=17269.

seen in the limited sense of raising awareness among particular groups of society about the provisions of the CWC, today it is seen in a much broader and more substantive sense as an important element of national implementation and as a foundation for preventing the re-emergence of chemical weapons.

Major Relevant Trends for Education and Outreach External to the CWC and OPCW

In addition to the developments described above that are shaping the future of the CWC and the OPCW and hence the importance of education and outreach to these changing missions, there are major trends beyond the immediate CWC/OPCW context that offer significant opportunities to make education and outreach efforts more effective. This section describes a number of those trends. As the project on *Multiple Uses of Chemicals* described in the next chapter reflects, the way in which an issue is presented can have a critical impact on how it is received. Given the importance of reaching multiple groups of stakeholders, it seems reasonable to introduce the CWC and the importance of preventing the re-emergence of chemical weapons within contexts that are already familiar and accepted frameworks for responsible conduct. Formal education and public outreach frameworks should provide entry points that are compatible with training and education for those who will deal directly with security and safety issues. Education and outreach should be compatible with discussions of ethical responsibilities and voluntary actions, as well as existing legal and regulatory structures and obligations. Fortunately, the OPCW can draw on a number of rich contexts to engage its key stakeholders.

CBRN Safety and Security Culture

The concept of "security culture" first emerged in the nuclear arena, based on lessons learned in the early days of Cooperative Threat Reduction programs in the former Soviet Union. Upgrading physical security, providing modern equipment, and instituting new procedures would have limited impact if they were not accompanied by the support of committed leaders and an engaged workforce. The concept is a subset of a larger body of research on organizational culture—what it takes to create and sustain successful organizations—that, appropriately adapted, applies to many types of organizations in many sectors.[8]

As the initial source of the concept for non-proliferation and disarmament of weapons of mass destruction (WMD), the nuclear sector has made the most progress in incorporating the concept of security culture and providing the tools to implement it in programming. Promoting a nuclear security culture has featured prominently on the agendas of all three Nuclear Security Summits (2010, 2012, and 2014). As early as 2008, the IAEA released its *Implementing Guide for Nuclear Security Culture*. Since then it has sponsored almost two dozen international, regional and national workshops and has formed a Nuclear Security Support Centre (NSSC) network which can promote the training of security culture within training centres. To operationalise the concept, guidance documents provide the tools for facility self-assessments and methodologies to enhance what is found.[9]

Other non-proliferation and disarmament organizations and coalitions have become interested in the contributions that developing common approaches to security culture across the domains of CBRN could make. The United Nations Office of Disarmament Affairs has supported outreach events related to security culture in different regions. A one-day conference on *A Road Map for Comprehensive and Sustainable CBRN*

8 See, for example, the discussion in National Research Council, *Safe Science: Promoting a Culture of Safety in Academic Chemical Laboratories*, National Academies Press, Washington, (2014), pp.17-34, available at http://www.nap.edu/catalog.php?record_id=18706.

9 A list of documents may be found at http://www-ns.iaea.org/security/nss-publications.asp. In particular, see IAEA, *Self-Assessment of Nuclear Security Culture in Facilities and Activities That Use Nuclear and/or Radiological Material, Draft Technical Guidance 13* (2014), http://www-ns.iaea.org/downloads/security/security-series-drafts/tech-guidance/nst026.pdf.

Security Culture, which the Global Partnership invited the SAB to attend for the first time, was held in Berlin, for example, in early November 2014 in conjunction with the meetings of two sub-working groups of the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction. Measures that support the development or strengthening of security culture could also complement other efforts to meet national obligations under United Nations Security Council resolution 1540. The promotion of security culture is sometimes coupled with a strong emphasis on the safe use of materials in recognition of the extensive overlaps between the two, and the degree to which a strong safety culture can provide an important foundation for fostering a strong security culture. The OPCW has played a leading role in the development of this approach in the CWC context. For example, in September 2011, as part of the International Year of Chemistry, the OPCW hosted a major conference on *International Cooperation and Chemical Safety and Security*.[10] The Outcome Document from the conference contains a number of recommendations related to education and outreach.[11] The final report of the Third Review Conference also recognized the responsibilities and roles of the States Parties and the OPCW in promoting a culture of chemical safety and security:

> "9.126 The Third Review Conference recalled that chemical safety and security, while being two distinct processes, are the prime responsibilities of States Parties. It encouraged the promotion of a safety and security culture regarding chemical facilities and of transportation of toxic chemicals. It noted that capacity-building activities in these fields are one of the elements of the decision on components of an agreed framework for the full implementation of Article XI adopted by the Conference at its Sixteenth Session (C-16/DEC.10).
>
> 9.127 The Third Review Conference noted the initiatives taken by States Parties and the Secretariat to promote activities in the areas of chemical safety and security, and welcomed the role of the OPCW as a platform for voluntary consultations and cooperation among the States Parties and the relevant stakeholders, including the private sector and academia, to promote a global chemical safety and security culture".[12]

One key reason for the relevance of safety and security culture to education and outreach lies in the importance of awareness and the fundamental role of core values. A classic definition of organizational culture is:

> "… a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems".[13]

As noted above, the engagement and commitment of personnel is vital to the creation and maintenance of safety and security culture. But people are not blank slates or empty vessels; they arrive with attitudes, experiences and values already in place that will shape their performance and willingness to accept the demands that adhering to a strong culture places on them. Education can provide an introduction to the core values necessary for sustaining a safety and security culture, thus providing a foundation on which such cultures can be more readily constructed.

Responsible Science

Given the key roles that scientists and engineers play in many sectors that are important to the success of the CWC's missions, using the framework of "Responsible Science" offers the opportunity to present chemical security and safety as part of the wider responsibility of science to society. The argument that one is building

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10 Information about the conference is available at http://www.opcw.org/special-sections/chemicals-conference/, including an archive of the presentations and a link to the Outcome Document.

11 Available at http://www.opcw.org/fileadmin/OPCW/PDF/IYC_Conference_Outcomes.pdf.

12 RC-3/3*, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=16406.

13 Edgar Schein, *Organizational Culture and Leadership*, 3rd edition, John Wiley and Sons, Inc, Hoboken, NJ (2004).

on or expanding an existing culture to address new issues also has the advantage of "making scientists part of the solution, not part of the problem". As discussed earlier in the chapter, this kind of emphasis on responsible science has become particularly important as the focus shifts to activities such as preventing terrorism. Preventing re-emergence needs the engagement and support of scientists, engineers and technical personnel who would not themselves be considered potential security risks. The discussions of responsible conduct and research integrity that have grown up in response to the continuing global diffusion of research and industrial capacity provide another opportunity to underscore that the new capacity is developed and managed in ways that support safety and security. These discussions are particularly important because they are coming from within the scientific community itself. One example of the prominence and visibility of this shift in thinking was the creation of the Committee on Freedom and Responsibility in the Conduct of Science (CFRS) by the International Council of Science (ICSU) to explicitly provide guidance on the responsibilities of scientists.

At present, the use of Responsible Science frameworks is more developed in education about biological weapons non-proliferation and disarmament, but the increasing convergence of chemistry and biology means that lessons from that realm are relevant and applicable to the CWC.[14] Within the last decade, a number of organizations engaged in biosecurity education have successfully used concepts from the social responsibility of science to introduce issues related to the potential dual-use implications of rapid advances in science and technology and the responsibilities of scientists to help mitigate the risks of misuse.[15] The projects are also making increasing use of active learning approaches, thus increasing the likelihood that the education will have an impact.

The Responsible Science framing is also gaining recognition by international non-proliferation and disarmament organizations and coalitions. Again, this is largely but certainly not exclusively with regard to biosecurity, if only because the impact of the revolution in the life sciences, and hence the need to engage the scientific community, is widely recognized. "Reduce proliferation risks through the advancement and promotion of safe and responsible conduct in the biological sciences" is one of five deliverables for the Biological Security Sub Working Group of the Global Partnership Program, for example.[16] The UK government chose "Responsible Science" as the theme for the October 2013 Global Partnership meeting under its presidency.[17] The report of the 2013 Meeting of States Parties to the Biological Weapons Convention concluded that "to further efforts on education and awareness-raising about risks and benefits of life sciences and biotechnology, States Parties agreed on the value of using science responsibly as an overarching theme to enable parallel outreach efforts across inter-related scientific disciplines …".[18] This conclusion is directly relevant to potential cooperation in education and outreach in areas of convergence relevant to the CWC and Biological Weapons Convention.

With regard to the CWC and OPCW, the Director-General used the opportunity of his speech accepting the Nobel Peace Prize to state that "Our aim is to contribute to efforts towards fostering a culture of responsible science. This will ensure that current and future generations of scientists understand – and respect –

14 For more on the subject of convergence between chemistry and biology, see OPCW, *Convergence of Chemistry and Biology: Report of the Scientific Advisory Board's Temporary Working Group*, June 2014, available at http://www.opcw.org/news/article/opcw-scientific-advisory-board-issues-report-on-the-convergence-of-chemistry-and-biology/and also information on the Spiez Convergence conferences, the first of which took place from 6-9 October 2014, more information is available at http://www.labor-spiez.ch/en/die/sc/index.htm.

15 Examples of such activities were presented at a side event during the August 2014 Meeting of States Parties to the Biological Weapons Convention; copies of the presentations may be found under the "Side Events" heading at http://www.unog.ch/80256EE600585943/(httpPages)/F837B6E7A401A21CC1257A150050CB2A?OpenDocument.

16 Global Partnership Against Weapons and Materials of Mass Destruction, *2012 Global Partnership Biological Security Deliverables*, available at http://geneva.usmission.gov/wp-content/uploads/2012/12/GP-Deliverables.pdf.

17 UK Foreign and Commonwealth Office, *Global Partnership Against Weapons and Materials of Mass Destruction: President's Report for 2013*, London, p.5, available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/269504/UK_2013_GP_Report.pdf.

18 Biological Weapons Convention, 2013, Report of the Meeting of States Parties, BWC/MSP/2013/5, p. 8, available at http://daccess-dds-ny.un.org/doc/UNDOC/GEN/G14/600/07/PDF/G1460007.pdf?OpenElement.

the impact that their work can have on security".[19] The activities described in the next chapter and the recommendations of the TWG illustrate current applications of the Responsible Science framework and its potential for the future work of the organization and its allies in the scientific community.

Statements on Responsible Science

Even scientists conducting the most fundamental research need to be aware that their work can ultimately have a great impact on society. Construction of the atomic bomb and the development of recombinant DNA—events that grew out of basic research on the nucleus of the atom and investigations of certain bacterial enzymes, respectively—are two examples of how seemingly arcane areas of science can have tremendous societal consequences. The occurrence and consequences of discoveries in basic research are virtually impossible to foresee. Nevertheless, the scientific community must recognize the potential for such discoveries and be prepared to address the questions that they raise. If scientists do find that their discoveries have implications for some important aspect of public affairs, they have a responsibility to call attention to the public issues involved. . . . science and technology have become such integral parts of society that scientists can no longer isolate themselves from societal concerns. (*On Being a Scientist*, 1st Edition, 1995)

The standards of science extend beyond responsibilities that are internal to the scientific community. Researchers also have a responsibility to reflect on how their work and the knowledge they are generating might be used in the broader society. (*On Being a Scientist*, 2nd Edition, 2009)

…Such practice, in all its aspects, requires freedom of movement, association, expression and communication for scientists, as well as equitable access to data, information, and other resources for research. It requires responsibility at all levels to carry out and communicate scientific work with integrity, respect, fairness, trustworthiness, and transparency, recognising its benefits and possible harms. (ICSU statute on Universality of Science, amended in 2011 to include responsibility)

Researchers should bear in mind the possible consequences of their work, including harmful consequences, in planning research projects. (IAP/InterAcademy Council, *Responsible Conduct in the Global Research Enterprise,* 2012)

Responsible Research and Innovation

Over the last decade, the European Commission has developed a concept to guide its approach to research funding that is rooted in issues of the social responsibility of science. As Máire Geoghegan-Quinn, the former European Commissioner for Research, Innovation and Science noted in a speech in 2012:

> "The dialogue between science and the rest of society has never been more important … After ten years of action at EU level to develop and promote the role of science in society, at least one thing is very clear: we can only find the right answers to the challenges we face by involving as many stakeholders as possible in the research and innovation process. Research and innovation must respond to the needs and ambitions of society, reflect its values, and be responsible. To my mind, there are a number of keys to doing this".[20]

19 OPCW, "Nobel Peace Prize Lecture: Working Together for a World Free of Chemical Weapons, and Beyond", *OPCW Today*, Vol. 2 No. 5 (2013), pp. 6-11, available at https://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_2_No_5.pdf.

20 Máire Geoghegan-Quinn, *Message delivered at the conference "Science in Dialogue - Towards a European Model for Responsible Research and Innovation,"* Odense, Denmark, 23-25 April 2012, http://ec.europa.eu/research/science-society/document_library/

The initial effort was a "Science and Society" Action Plan in 2001 that sought to provide a common strategy that would improve scientific research and European citizens. The next major step came in 2007 under the 7th Framework Programme for Research and Technological Development. A change from "Science and Society" to "Science *in* Society" reflected the determination to promote genuine public engagement and more sustained communication between science and civil society. Beginning in 2010, emphasis has been on "Responsible Research and Innovation (RRI), which "means that societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes, with the values, needs and expectations of European society".[21] The European Commission, as part of its Horizon 2020 Programme has funded a number of projects related to the governance of research that are also potentially relevant to the OPCW in its outreach to academia and given its explicit inclusion of technology, to portions of industry as well.[22]

Responsible Care

In the mid-1980s, in response to public concerns about the manufacture, distribution and use of chemicals, the Canadian Chemical Producers Association launched the "Responsible Care" initiative – a global, voluntary effort by chemical companies, national chemical industry associations, and their partners. In the intervening years, Responsible Care has expanded to include 57 national and regional associations in 60 economies. At the international level, the primary industry association for Responsible Care is the International Council of Chemical Associations (ICCA). In addition, all major chemical manufacturers have implemented Responsible Care programmes that are applied throughout their global network of subsidiaries and extend to their suppliers and distributors.

Among the commitments undertaken by adherents to Responsible Care are to:

- Continuously improve the environmental, health, safety and security knowledge and performance of technologies, processes and products over their life cycles so as to avoid harm to people and the environment;
- Use resources efficiently and minimise waste;
- Report openly on performance, achievements and shortcomings;
- Listen, engage and work with people to understand and address their concerns and expectations;
- Cooperate with governments and organisations in the development and implementation of effective regulations and standards, and to meet or go beyond them; and
- Provide help and advice to foster the responsible management of chemicals by all those who manage and use them along the product chain.[23]

Responsible Care has provided an important framework for OPCW's outreach to industry on issues of chemical safety and security. In return, as the cover letter for the ICCA position paper for the Third Review Conference stated:

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pdf_06/responsible-research-and-innovation-leaflet_en.pdf.

21 European Commission. *Responsible Research and Innovation: Europe's Ability to Respond to Societal Challenges*, http://ec.europa.eu/research/science-society/document_library/pdf_06/responsible-research-and-innovation-leaflet_en.pdf.

22 See, for example, Hilary Sutcliffe, *A Report on Responsible Research and Innovation*, available at http://ec.europa.eu/research/science-society/document_library/pdf_06/rri-report-hilary-sutcliffe_en.pdf.

23 CEFIC website, http://www.cefic.org/Responsible-Care/, accessed November 12, 2014.

"The Chemical Weapons Convention receives the full, unconditional support of the global chemical industry. ICCA, which represents the global chemical industry, wishes to reaffirm that its membership remains committed to and involved in implementing the Convention at [the] national, regional and international level. Industry support is a natural extension of its globally recognized Responsible Care programme, especially the Global Product Strategy, which requires the responsible stewardship of chemical products throughout the supply chain".[24]

Green Chemistry

The TWG determined that a particularly important community to work closely with in the future, in light of the new emphasis for the OPCW on the responsible uses of chemicals, is the green and sustainable chemistry community. The term "green chemistry" describes a 20+ year old set of initiatives to formally create networks of scientists and educators that overtly and visibly give attention to the design of chemical processes that maximize the amount of raw material that ends up in products; that uses safe and environmentally benign substances and synthetic methodologies; and that maximize energy efficiency in chemical processes. The community has developed a substantial profile, both nationally and internationally, with regular conferences, well-recognized scientific journals, and incentives to support and recognize innovative research and education in green chemistry. At the heart of green chemistry is a philosophy of sustainability, and the TWG has been interested in exploring more carefully with this community the web of connections among safety, security, and sustainability with respect to the use of chemicals, reactions and processes. This interest motivated the substantial involvement by the OPCW in the International Conference on Green Chemistry in Durban, South Africa, in August 2014, in which three TWG members and two Secretariat staff members made presentations, and TWG member Peter Mahaffy gave a plenary talk that connected chemistry education for security and sustainability to the green chemistry focus of the conference.

Opportunities Across Broader Non-proliferation and Disarmament: Recognition of the Importance of Education and Outreach

Education is not a new topic in international non-proliferation and disarmament. In 2002, for example, the United Nations released a Study on Disarmament and Non-Proliferation Education that provided 34 recommendations for action by a wide variety of stakeholders, including educators and academic institutions.[25] In recent years that interest has revived, reflected in activities across the spectrum of WMD. Some of the activities are focused on encouraging a "next generation" of experts able to carry out work directly related to reducing the risks of proliferation or supporting the implementation of treaties and agreements. Other efforts focus on engaging the wider scientific and technical community to raise awareness of the existence of treaties such as the CWC and build support for its goals and effective implementation. Finally, some activities respond to the UN report's call to "impart knowledge and skills to empower individuals to make their contribution, as national and world citizens".[26]

The most ambitious initiatives are in the realm of nuclear non-proliferation and disarmament. The International Nuclear Security Education Network (INSEN) of the International Atomic Energy Agency (IAEA) has grown since its creation in 2010 to include over 90 universities and research institutes from all over the world.[27] The IAEA supported the development and publication of a guidance document that provides the

24 *ICCA Position Paper for the Third Review Conference of the States Parties of the Chemical Weapons Convention*, available at http://www.icca-chem.org/ICCADocs/ICCA%20%20position%20paper%203rd%20review%20Conference%20OPCW.pdf.

25 United Nations, 2002, United Nations study on disarmament and non-proliferation education, Report of the Secretary-General, A/57/124, available at http://www.un.org/ga/search/view_doc.asp?symbol=A/57/124.

26 Ibid., p.10.

27 For more information, see Jason Harris, "Networking for nuclear security: The International Nuclear Security Education

model for both a masters-level graduate programme and a certificate programme in nuclear security.[28] INSEN continues to sponsor and support a variety of workshops and other training and collaborative activities. In addition to providing more traditional short courses and training, the Comprehensive Test Ban Treaty Organization (CTBTO) has put particular emphasis on the use of innovative approaches, such as the growth of online education, through the creation of an e-learning platform. CTBTO's goal is "building and maintaining the necessary capacity in the technical, scientific, legal and political aspects of the Treaty and its verification regime". As part of its outreach to the broader public, it has an iTunes U page to provide access to lectures, briefings, and materials from CTBTO staff and other experts.[29]

The website of the UN Office for Disarmament Affairs offers many education resources

The Biological Weapons Convention (BWC) has long recognized the importance of education as part of the "web of prevention" to counter biological threats.[30] Endorsements of education are routinely included in the final documents of review conferences and education is a standing agenda item in the current 2012-2015 intersessional period.[31] In this case, the projects and programmes related to BWC-relevant education are largely the result of initiatives by individuals and NGOs supported by foundations and governments, with the exception of the regional CBRN Centres of Excellence (CoEs) supported by the European Union.[32]

All of these initiatives provided the basis for discussions with the TWG on potential communication and collaboration as well as the opportunity to share experiences and lessons. Brief reports of those discussions are included in Chapter III.

Network", *OPCW Today*, Vol. 2, No. 5 (December 2013), pp. 40-41, available at https://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_2_No_5.pdf See also http://www-ns.iaea.org/security/workshops/insen-wshop.asp#1.

28 IAEA, *Educational Programme in Nuclear Security.* Vienna, (2010), available at http://www-pub.iaea.org/MTCD/publications/PDF/Pub1439_web.pdf.

29 See http://www.ctbto.org/specials/ctbto-cdi/.

30 The term was coined by the International Committee of the Red Cross as part of its "Biotechnology, Weapons and Humanity" campaign in the early 1990s. More information is available at http://www.icrc.org/eng/resources/documents/misc/5vdj7s.htm.

31 BWC, *Final Report of the 7th Review Conference*. Geneva (2011), available at http://www.unog.ch/__80256ee600585943.nsf/(httpPages)/f1cd974a1fde4794c125731a0037d96d?OpenDocument&ExpandSection=3.

32 Information about the Centres of Excellence may be found at http://www.unicri.it/topics/cbrn/coe/. There has been more emphasis on education in the CoE projects related to biosecurity than those for chemical security. Examples of a number of the initiatives and discussions of the continuing challenges facing biosecurity education may be found in Judy Sture (ed.), *Handbook of Biosecurity Education 2012*, Bradford Disarmament Research Centre, University of Bradford (2012), available at http://www.brad.ac.uk/bioethics/media/ssis/bioethics/Yearbook-of-Biosecurity-Education-ISBN-978-1-85143-271-4.pdf. The University of Bradford's own work may be found at http://www.brad.ac.uk/bioethics/about/.

Opportunities for New Tools and Innovative Applications

The materials for teaching and learning referred to in Chapter III which were chaperoned by the TWG are designed to promote discussion about chemistry and the uses to which it is put, and to infuse responsible science considerations into formal and informal educational context. Several key audiences were identified as targets for new materials. Practicing chemists and chemists-in training need to be targeted, as chemists are needed to make chemical weapons, and present and future chemists must be persuaded that they should have no part in the development of chemical weapons. However, most chemists are unaware of the CWC and what the treaty requires. Chemistry courses are also taken in secondary and post-secondary school settings as requisite content for many other science-related careers, and influencing future scientists about the responsible uses of chemicals is also necessary for broad scientific support of responsible science initiatives. Finally, informal public awareness of the responsible uses of chemicals is needed to provide the broad public support for the culture of responsible science that will prevent re-emergence.

To have the thought-provoking conversations and debates that the OPCW and the TWG seek to create requires actively engaging the audience. This means learning through participation and being active in the learning process. A substantial body of evidence in many scientific disciplines shows that this approach is a far more successful method of learning than the more traditional, student-passive, lecture-based instruction.[33]

TWG member Peter Mahaffy leads a workshop

Active learning approaches have been well validated. They incorporate classroom and/or other activities that require all students/participants to express their thinking through speaking, writing, or other actions that go beyond listening and taking notes. These learner-centred environments are generally more collaborative,

33 National Research Council, *How People Learn: Brain, Mind, Experience, and School* (Expanded Edition). Washington: National Academies Press (2000); Jo Handelsman, Sarah Miller and Christine Pfund, *Scientific Teaching*. San Francisco: Freeman and Sons (2007); Jennifer K. Knight and William B. Wood, "Teaching more by lecturing less", *Cell Biology Education*, Vol. 4, No. 4 (2005), pp. 298-310; Michael Prince, "Does active learning work? A review of the research", *Journal of Engineering Education,* Vol. 93, No. 3, (2004); National Research Council, *Promising Practices in Undergraduate Science, Technology, Engineering, and Mathematics Education: Summary of Two Workshops*. Washington: National Academies Press (2011); Daniel Meltzer and Ronald Thornton, "Resource Letter ALIP-1: Active-Learning Instruction in Physics", *American Journal of Physics*, Vol. 80, No. 6, (2012).

inquiry based, and relevant.[34] Many teaching strategies can support these and range from problem-solving/discussion sessions in a class setting to original investigations that may be student designed.

Active learning approaches work in a wide range of settings, from small group to large lecture-based courses and the approaches work with audiences who are predominately female or male, heterogeneous or of mixed gender. With larger audiences strategies can be used in which individuals can respond anonymously to questions posed or be more open and discuss responses with those sitting next to them before voicing opinions more broadly to the group. Some evidence suggests that small-group learning had a much greater positive effect for groups composed primarily of African American and Latino students compared with relatively heterogeneous groups and those composed predominantly of students of European descent.[35]

Active learning approaches used by TWG members Alastair Hay and Peter Mahaffy, however, with larger mixed (by gender, race and ethnicity) groups (including one with National Authorities) have led to sustained active participation and reflection by the audience. An active learning approach was used in late 2014 by Alastair Hay to introduce the *Multiple Uses of Chemicals* teaching material during workshops in Argentina, and also in workshops in Lebanon with mixed (male/female; Muslim/Christian) student audiences. Audience participation in both countries was significant and feedback indicated that the students liked the approach.

Additionally, workshops for teachers and college and university faculty increasingly use active learning methods; these approaches have also been used successfully by Alastair Hay in recent training exercises on laboratory safety and security and dual-use with academic chemists in the Middle East.[36]

Critical reflection is an essential component of virtually all effective approaches to learning. To date, this is the only practice that has demonstrated student learning gains in understanding the nature of science.[37] Reflection provides students with the opportunity to explore their level of understanding with other learners (and the teacher). The ethical and social issues involved in the responsible conduct of science are complex and it is important to include time for reflection.

One of the ways active learning courses can be designed is a process in which the first step is the identification of goals and objectives and then the learning activities. This "backward design" process, also called reverse design, is intended to ensure that learning objectives inform instructional and assessment strategies through explicit articulation of these two critical components of the learning process and then integrate them into the design of the course at the outset.[38] Assessment of learning may then be designed to monitor how students learn during their training (what is called formative assessment) and then at the end of a course to see what they know (summative assessment).

Many countries are now making an effort to change the way that science is taught. Evidence from classroom teaching where students are more actively engaged indicates that years after their instruction students have retained a "good" grasp of concepts,[39] and have developed the ability to apply those concepts to new problems and contexts. "Students who learn in small groups generally demonstrate greater academic

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34 Brewer, C., and D. Smith, (eds.), *Vision and Change in Undergraduate Biology Education*. Washington: American Association for the Advancement of Science (2011).

35 Springer, L., M. Stanne, S. Donovan, "Measuring the Success of Small-Group Learning in College-Level SMET Teaching: A Meta-Analysis", *Review of Educational Research*, Vol. 69, No.1 (1999), 21-51.

36 Additional evidence to support this approach has been gained through the experience of Education Institutes supported by the U.S. Department of State to create networks of faculty able to deal about biosecurity and dual use issues in the context of Responsible Science; see National Research Council, 2013.

37 National Research Council, *America's Lab Report: Investigations in High School Science*, Washington: National Academies Press, (2006); and National Research Council, *Ready, Set, Science!* Washington: National Academies Press, (2008).

38 Grant Wiggins, and Jay McTighe, *Understanding by Design*, Expanded 2nd ed. Upper Saddle River, NJ: Pearson Publishing (2005).

39 Jonte Bernhard, "Does Active Engagement Curricula Give Long-Lived Conceptual Understanding?" In *Physics Teacher Education Beyond 2000*, R. Pinto and S. Surinach (eds.), Paris: Elsevier (2001), pp. 749-752.

achievement, express more favorable attitudes toward learning", and remain enrolled in science, technology, engineering and mathematics courses and programmes "to a greater extent than their more traditionally taught counterparts".[40]

Another approach to promote student engagement and retention of knowledge is through the use of role plays and simulations. This approach is particularly widely used in political science, and has been applied to the disarmament and arms control field.[41] The benefits are similar to those already described for chemistry students: "Since simulations became more common as a teaching tool in the late 1950s, educational literature has expounded on their benefits, from encouraging engagement by breaking from the typical lecture format, to improving communication skills, to promoting teamwork. More broadly, simulations can deepen understanding by asking students to link fact and theory, providing a context for facts while bringing theory into the realm of practice".[42] A similar approach is Model United Nations (MUN), an educational simulation and academic competition in which participants learn about diplomacy, international relations and the United Nations. MUN involves and teaches research, public speaking, debating and writing skills, in addition to critical thinking, teamwork and leadership abilities. In the past two years, several MUN conferences have featured simulations of the OPCW and the OPCW has partnered with MUN conferences in The Hague.

It is such approaches to foster active learning, engagement by the audience in discussions which will both encourage reflection and lead to conceptual change about the role of chemistry, that the TWG sought to encourage.

The Student Amsterdam Model United Nations at the OPCW in September 2014

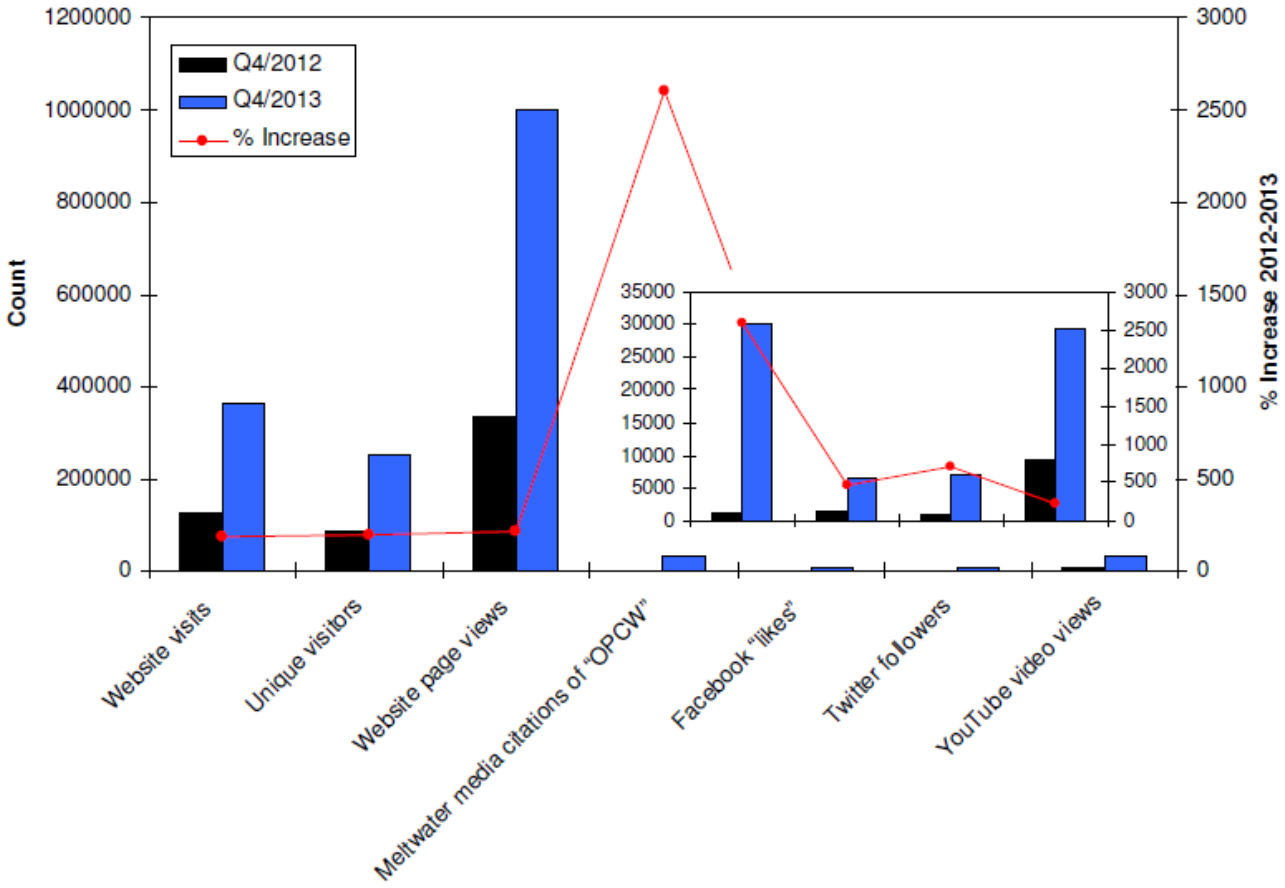
40 Springer, L., M. Stanne, S. Donovan, "Measuring the Success of Small-Group Learning in College-Level SMET Teaching: A Meta-Analysis", *Review of Educational Research*, Vol. 69, No. 1, (1999), p.42.

41 See, for example, Alexander Kelle, "Experiential Learning in an Arms Control Simulation", *PS: Political Science & Politics*, No.2 (April 2008), pp 379-385; Mark A. Boyer, "Simulation in International Studies", *Simulation & Gaming*, Vol. 42, No. 6, (December 2011), pp. 685-689; and Jane Esberg and Scott D. Sagan, "Negotiating Nonproliferation: Scholarship, Pedagogy, and Nuclear Weapons Policy", *The Nonproliferation Review*, Vol. 19, No. 1, (March 2012), pp. 95-108, available at http://dx.doi.org/10.1080/10736700.2012.655089.

42 Esberg and Sagan, p. 98.

A "Unique Constellation"

The OPCW now finds itself in a unique position from which to be able to exploit, build upon and make synergies between all the trends described in the preceding sections. The two-year period from the Third Review Conference in April 2013 to April 2015 encompasses a unique constellation of events including the 2013 Nobel Peace Prize, the centenary of the First World War, the approaching centenary of the first large-scale use of chemical weapons, the use of chemical weapons in Syria, the accession of Syria to the Convention and the subsequent destruction of Syria's chemical weapons stockpile. Taken together these events have resulted in a quantum leap in the profile of the OPCW which can be measured in numbers of visits to the OPCW website, interactions with OPCW on social media platforms like Facebook and Twitter and citations in the print and electronic media, as shown in the graphic below.



Increase in media coverage and and social media traffic, Q4 2013 compared to Q4 2012

The involvement of the OPCW in Syria in March 2013 followed the decision by the UN Secretary-General to establish an investigation into reports received from Member States of chemical weapons use during the civil war in Syria. The OPCW's involvement with regard to Syria in 2013 began with its contribution of resources to the Secretary-General's investigation, including the field activities and laboratory analysis in August and September 2013 following the chemical weapons attack in Ghouta on 21 August 2013. Within a month of the incident, it had been confirmed by the investigation mission as a chemical weapons attack and Syria had agreed to join the Chemical Weapons Convention. On 27 September, the OPCW Executive Council and the UN Security Council both adopted decisions laying out a framework for the elimination of Syria's chemical weapons programme. Within a few days, OPCW inspectors were on the ground in Syria verifying the information provided by the government on its chemical weapons programme. Subsequent OPCW decisions set out the process and timelines for the elimination of the chemical weapons, including their removal from Syria for destruction elsewhere.

The confirmed use of chemical weapons in Syria during 2013 and the subsequent joint OPCW-UN efforts to eliminate Syria's chemical weapons programme has massively increased the profile of the OPCW. The OPCW before 2013 has been described as a "sleepy backwater of nonproliferation and disarmament",[43] particularly when compared with the better-known IAEA in Vienna. In the midst of the initial wave of inspections in Syria, another event took place which heightened the profile of the OPCW even further; the award of the 2013 Nobel Peace Prize to the OPCW. The award was announced by the Norwegian Nobel Committee on 11 October 2013 and made the top story on many news websites. In one day, the number of "likes" for the OPCW on Facebook increased by 1,000. While the Nobel Committee emphasised that the award was for the OPCW's "extensive efforts to eliminate chemical weapons", many people associated it with the ongoing deployment of OPCW inspectors in Syria. Attention increased again on 10 December 2013 when the OPCW Director-General received the Nobel Peace Prize on behalf of the Organisation in Oslo and delivered a lecture which was webcast live. In his lecture, the Director-General stressed the importance of education:

> "We need to deal with the situation in which, as Isaac Asimov put it, 'science gathers knowledge faster than society gathers wisdom'. It is for this reason that the OPCW has worked hard to enhance awareness of the often fine line between beneficial and harmful applications in chemistry through education programmes and outreach to academia. Our aim is to contribute to efforts towards fostering a culture of responsible science. This will ensure that current and future generations of scientists understand – and respect – the impact that their work can have on security".[44]

OPCW Director-General Ahmet Üzümcü at the Nobel Peace Prize ceremony in Oslo on 10 December 2013

43 Amy Smithson, "How to Dismantle a Chemical Bomb: Lessons for the United Nations in Syria", *Foreign Affairs*, 18 September 2013, available at http://www.foreignaffairs.com/articles/139940/amy-e-smithson/how-to-dismantle-a-chemical-bomb.

44 OPCW, "2013 Nobel Peace Prize Lecture: Working Together for a World Free of Chemical Weapons, and Beyond", *OPCW Today*, Vol. 2 No. 5 (December 2013), pp.6-11.

The Nobel Peace Prize also brings with it a legacy which will last for many years, with the Organisation being referred to as "the Nobel Peace Prize-winning OPCW". Furthermore, it has opened up engagement possibilities which were not previously available to the OPCW, for example the display of an exhibition about the OPCW at the Nobel Peace Center in Oslo and participation in events such as the Nobel Peace Prize Forum. The legacy of the Nobel Peace Prize will also be sustained by the annual presentation of an OPCW-The Hague Award to honour and recognise individuals and non-profit, non-governmental organisations that have made an outstanding contribution to achieving a world free of chemical weapons. The Award has been made possible by the award money from the Nobel Peace Prize itself, and a financial contribution from the City of The Hague. The joint winners of the first OPCW-The Hague Award were announced on 4 November 2014 and one of them, Dr Robert Mathews of Australia, is a member of the TWG.

Awareness of chemical weapons in a more general sense in the 2013 to 2015 timeframe is also heightened by the centenary of the First World War in the years 2014 to 2018. The First World War is sometimes referred to as "The Chemist's War" due to the fact that it was the first conflict in which chemical weapons were used on a large-scale on the battlefield. The centenary of the very first large-scale use of chemical weapons in the First World War will be marked on 22 April 2015 with several events in and around the Belgian town of Ieper where the first attack took place. On the day before, the OPCW will hold a meeting of its Member States in Ieper in order to commemorate the victims of chemical warfare. The centenary will be an opportunity to raise awareness about the OPCW and its activities, but also to raise concepts of scientific responsibility.

III. Findings and Activities

In addition to the information gathering, research, and discussion normally associated with a TWG, the TWG on Education and Outreach was able to undertake several concrete activities to meet its objectives during the course of its mandate. It was also able to take advantage of initiatives already under way and work to support and advance them. The TWG was thus a "working" group in a very real sense and very active in promoting the OPCW.

In addition, the TWG offered findings and recommendations in each of the reports from its first three meetings.[1] These reports were endorsed by the SAB and many of the recommendations have been implemented by the Secretariat or by States Parties or have led to additional TWG activities.

This chapter offers a discussion of the TWG's major activities in response to its mandate, with the exception of its recommendations for how to make OPCW's education and outreach activities sustainable. Those are addressed in Chapter IV.

Raising Awareness of the Convention in the Education Sector

As described in Chapter I, the OPCW's engagement in education and outreach began early. The TWG was able to take advantage of a number of past and current initiatives, including the joint OPCW/IUPAC *Multiple Uses of Chemicals*, a set of web-based educational materials developed in 2005 and intended primarily for university audiences, and the *Fires* project to produce short, accessible films for a range of audiences. The TWG was also able to help foster a new project for high school chemistry students. This section provides descriptions of each of these three projects.

"Multiple Uses of Chemicals" Website

The desire to ensure that stories about responsible choices regarding the multiple uses of chemicals are told to students, the public and policy makers has provided the motivation for IUPAC and the OPCW to work together. As Director-General Üzümcü emphasised in his Nobel Peace Prize Lecture in December 2013, organizations need to think "about how [they] can employ new communication tools to raise awareness of the need to practice responsible science, to instil the highest ethical standards in our future scientists and researchers".[2]

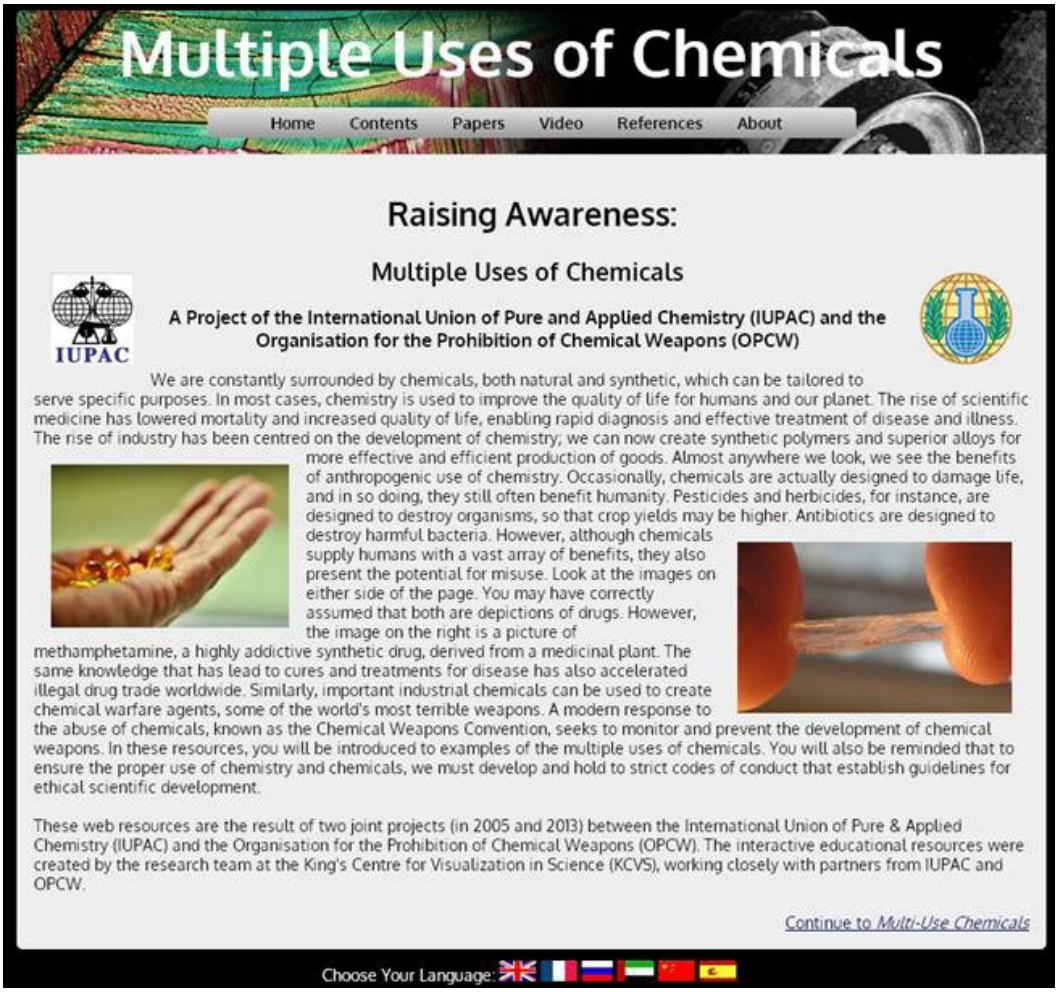
As described in Chapter I, various initiatives have been supported for over a decade to give emphasis to education and awareness about the responsible practice of science. One concrete step toward raising awareness of the need to practice responsible science was a joint IUPAC-OPCW project in 2005 to create a set of interactive electronic materials, *Multiple Uses of Chemicals*. This website introduces students, educators and policymakers to the topic of multi-use chemicals and discusses how such chemicals can be used for beneficial purposes and misused to create illegal drugs or even chemical weapons. The project was led by TWG members Peter Mahaffy from Canada and Alastair Hay from the UK, who were leaders in IUPAC's chemistry education work.

1 The reports of TWG meetings may be found at https://www.opcw.org/documents-reports/subsidiary-bodies/scientific-advisory-board/reports/.

2 OPCW, "2013 Nobel Peace Prize Lecture: Working Together for a World Free of Chemical Weapons, and Beyond", *OPCW Today*, Vol. 2 No. 5 (December 2013), pp.6-11.

The term "multi-use chemicals" is used intentionally, as recommended by the 2005 Oxford IUPAC-OPCW conference,[3] to emphasize the shades of grey that are present in decision-making about the responsible uses of chemicals. Sometimes chemicals are used in ways that are evidently either ethical or unethical, but more often a spectrum of purposes is present, and the effect of a chemical substance or reaction depends on the context of its use and the intent of its user. For this reason, particularly in educational and outreach contexts, it was felt to be important to engage users with the complexity of classification of uses and the challenges in developing responsible practices to guide the choices students, educators and policy makers and the public make each day about chemicals, most of which are beneficial.

Although the website received several thousand visitors each year, the project had not had the resources to take advantage of the many advances in interactive, web-based education. Since both Mahaffy and Hay were members of the TWG, this offered the opportunity to update *Multiple Uses* and involve other members of the Group in the modernization of this important resource.



A screenshot from the Multiple Uses of Chemicals website

Funds from the European Union through the OPCW and another joint OPCW-IUPAC project made it possible to update the website. An interdisciplinary team of undergraduate students and faculty members at the King's Centre for Visualization in Science (Edmonton, Canada), under the direction of Peter Mahaffy and Brian Martin, developed the educational materials, in close consultation with scientists and educational specialists from both IUPAC and the OPCW.[4]

3 Graham S. Pearson, and Peter Mahaffy, "Education, outreach, and codes of conduct to further the norms and obligations of the Chemical Weapons Convention (IUPAC Technical Report)", *Pure and Applied Chemistry*, Vol. 78, No. 11 (2006), pp. 2169-2192, available at http://www.iupac.org/publications/pac/pdf/2006/pdf/7811x2169.pdf.

4 Peter Mahaffy, Joseph Zondervan, Alastair Hay, Daniel Feakes, and Jonathan Forman, "Multiple Uses of Chemicals – IUPAC and OPCW Working Together Toward Responsible Science", *Chemistry International*, Vol. 36, No. 5 (September 2014), pp. 9-13,

Following best practices in the design of electronic learning materials, the expanded *Multiple Uses of Chemicals* website resource was made with interactivity in mind, implementing a variety of case studies and role-playing scenarios to communicate information effectively. To engage a wide range of audiences while delivering content appropriate to each type of user, the resource starts with three separate portals: Brief Overview, Students, and Educators and Policymakers. The Brief Overview displays the major features of the resource, and is highly condensed for easy navigation through the site. The Students portal targets secondary and post-secondary chemistry classes, and can be used to stimulate discussions of scientific responsibility and integrity in the context of applications of various concepts in general and organic chemistry, or to support courses in ethics. Interactive resources for students include role-playing scenarios, case studies and a variety of personal and discussion questions. The Educators and Policymakers section contains tips for implementing the resource into presentations or classroom discussions, as well as a list of learning outcomes for each topic, supplementary resources such as worksheets for students, and links to other websites that may be useful in preparing presentations or lectures. The website is divided into four major sections: Multi-Use Chemicals, Responsible Choices in Chemistry, Convergence of Chemistry and Biology, and Codes of Conduct. The majority of the content is in the first two sections, where users are introduced to the concept of multi-use chemicals and the problems associated with their regulation and distribution.

The Multiple Uses of Chemicals resource has been piloted at several recent workshops for chemists and educators, including the August 2013 44th IUPAC World Chemistry Congress in Istanbul. The video of this workshop has been posted on the website, to give presenters tips for implementing the resource into their presentations and discussions. A workshop was held at the OPCW regional meeting on responsible use of chemicals in Argentina in April 2014, and another workshop took place during the 5th IUPAC Conference on Green Chemistry in South Africa in August 2014.

With the profiling of the multiple uses resources on both the IUPAC and OPCW websites, substantial increases in traffic to the site have been measured, with 10,000 unique visits to the resources during the most recent six months of 2014, from over 75 countries. The website can be accessed at http://multiple.kcvs.ca/site/index.html.

The "Fires" Project

Two short films are available as part of the "Fires" project which originated with the goal of raising the visibility of OPCW and humanising its work for a broad audience. The topic of chemical weapons elimination is shown from a human society perspective. The characters range from everyday people to OPCW staff members, showing stories of humans connected to chemical weapons, emphasizing that it is a concern of all.

Many institutions, because they try to communicate about their achievements, watch themselves in a mirror. Their messages speak about themselves and so cannot properly address a wide audience. The everyday person does not care about them – why would they? The mirror between the institution and the audience looks like a blind screen. To efficiently communicate, it is worthwhile trying to invert the mirror towards the audience. When the viewers see themselves in the mirror – i.e. when he or she identifies with the characters on the screen, when they can relate to the stories being told – they understand that the author cares. Their attention is caught and the audience watches towards the source, towards the institution. By showing, episode after episode, intertwining stories of simple individuals who, as survivors, scientists, humanitarian workers, international staff, are involved with chemical weapons, the Fires Project tries to address the mirror case: by inverting the mirror towards people, it helps them to grasp that the CWC is first and foremost of public interest. It is for them.

Chrétien Schouteten, a retired high school chemistry teacher from Groningen in the Netherlands, has spent most of his career being concerned about chemists' responsibilities towards society. A scientist's knowledge is a powerful tool that can serve many purposes, but what is the value of science to humanity without ethics?

available at http://www.degruyter.com/view/j/ci.2014.36.issue-5/ci-2014-0508/ci-2014-0508.xml?format=INT .

Long before the signature of the Chemical Weapons Convention and the Nobel Peace Prize, Mr. Schouteten was already sensitizing his pupils to the issue of ethics and chemistry, challenging them to imagine what they would do if their knowledge were demanded not for noble causes, but for evil purposes.

To address a wider audience on this theme, Schouteten wrote a theatrical play about the life of Fritz Haber, the father of modern chemical warfare who also won the Nobel Prize for inventing the synthesis of ammonia – an invention that enabled the mass production of fertilizers and has fed the world ever since. Schouteten's enduring aim is to create awareness about the potential misuse of chemistry as a contemporary issue, not buried in the past, but one that engages and affects all.[5]

In August 2011, Schouteten made a phone call to the OPCW. By chance, Schouteten reached Eric Vander Borght, recently hired as the new OPCW video producer and photographer. Chrétien's proactive approach and profile inspired Eric to produce a movie about his innovative cross-over pedagogy, a mix of hard science and ethics. Chemical weapons were designed by scientists, therefore it is important to sensitize future scientists when they still are young pupils argues Schouteten. Sensitization and knowledge are like fires he says. If everyone, with his own little fire, contributes to global knowledge, then the world would be safer.

A scene from "Fires: A Teacher's Mission"

This film became the first in the Fires Project, entitled "A Teacher's Mission". It has since been screened at numerous OPCW and other events receiving many positive comments from viewers. For instance, it was presented at the Nobel Peace Prize Forum in Minneapolis on 9 March 2014. The second film in the series was shown at a public screening in Lomé on 11 August 2014 organised by the United Nations Regional Centre for Peace and Disarmament in Africa.

The films can be found at www.thefiresproject.com The film featuring Chretien Schouteten has already been subtitled into all official OPCW languages with financial support from the United Kingdom of Great Britain and Northern Ireland. Schouteten has also written an accompanying lesson plan for use by teachers, and also translated into all official languages.

5 For more information, see Chretien Schouteten, "Chemistry and Ethics in Secondary Education: 25 Years of Experience with Classroom Teaching on Chemical Weapons", *OPCW Today*, Vol. 2, No. 5 (December 2013), pp. 33-35, available at https://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_2_No_5.pdf.

"Chemistry in Conflict" Educational Module

One of the objectives of the TWG has been to report to the SAB on ways in which to raise awareness of the Convention in the education sector, and one particular area of focus was on the development of teaching materials. TWG member Jan Apotheker from the Netherlands has been involved in national curriculum development and he facilitated the establishment of a project to develop a modular course on chemical weapons issues for use in the secondary level of education. The project was coordinated by Ludo Juurlink from the University of Leiden with financial support from the government of the UK, Leiden University and the Municipality of The Hague. Working with a small group of high school chemistry teachers from Dutch and international schools in and around The Hague, and an expert from the International Baccalaureate Organisation, an educational module entitled "Chemistry in Conflict" was developed. The group also developed a teacher's handbook to guide teachers through the use of the module.[6]

Although targeted at chemistry students, the module takes a multidisciplinary approach by also involving history, ethics and media studies. The student workbook takes a modular approach whereby all four chapters can be studied together, or teachers can choose to study fewer chapters. The four chapters deal with the following topics: chemical weapons from the technical point of view; the CWC and its obligations; the ethics of the development of chemical weapons; and protection against chemical weapons. The module uses a range of learning approaches with suggestions for a role play, experiments using simple and easily available materials and student research projects.

Chemistry students at the Vrijzinnig Christelijk Lyceum in The Hague conduct one of the experiments in the workbook

6 For more information see Ludo Juurlink, "Chemistry in Conflict: Spreading the Word to High School Students", *OPCW Today*, Vol. 2, No. 5 (December 2013), pp. 25-26, available at https://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_2_No_5.pdf.

The module has been extensively tested and revised in local Dutch and international high schools and will also be translated into other official languages of the OPCW when funds allow. The module will soon be freely available for use in high schools around the world. It will also be disseminated within the International Baccalaureate Organisation which works with 3,841 schools in 147 countries to develop and offer programmes to over 1,205,000 students aged 3 to 19 years.

Developing the OPCW's Relationships with the Scientific Community and Chemical Industry

The second main objective of the TWG was to report to the SAB on "Proposals for how the OPCW could further develop its relationships with the scientific community and the chemical industry with a view to raising awareness of the requirements of the Convention and promoting universal adherence to it". As the objective alludes to, the OPCW already had relationships with the scientific community and the chemical industry. With respect to the former, much of the history has already been described in Chapter I of this report, so this section describes developments since the establishment of the TWG in April 2012. With respect to the latter, the Third Review Conference gave renewed impetus to the OPCW's relationship with the chemical industry and the results will be described in brief below. Much has been achieved in this area since the inception of the TWG, partly due to the activities and efforts of its members. Relevant recommendations of the Third Review Conference helped, as did the implementation of the recommendation from the Advisory Panel on Future OPCW Priorities to create the post of Science Policy Adviser within the Secretariat.

Relations with the Scientific Community

The Third Review Conference "encouraged the Secretariat to continue to develop relationships and partnerships with other relevant bodies, national and international, that are working to promote the peaceful and responsible use of chemistry, including capacity building".[7] IUPAC has been a logical partner for the OPCW in implementing this recommendation as "the only independent, nongovernmental, international organization devoted to chemistry and the chemical sciences and their application in research, industry, and society".[8] The TWG has therefore made a number of recommendations regarding the need to further develop the relationship between the OPCW and IUPAC, particularly with its Committee on Chemistry Education (CCE). In 2012, a representative of the Secretariat and the Chairman of the TWG participated in a meeting of CCE in Rome with the latter giving a presentation about the work of the TWG. At the CCE meeting, it was suggested that the OPCW should regularly participate in CCE meetings, an idea which was endorsed by the TWG at its second meeting. Further discussions took place at the subsequent CCE meetings in Istanbul in August 2013 and in Toronto in July 2014. In September 2014, the Secretariat was formally invited to appoint a representative to serve as an advisory member of CCE, and has since accepted the invitation. A representative of the Secretariat will attend the next CCE meeting during the 48th IUPAC General Assembly and 45th IUPAC World Chemistry Congress in Busan, South Korea in 2015.

The Secretariat and the TWG have also participated in the previous two IUPAC-organised International Conferences on Chemistry Education which took place in 2012 in Rome and in 2014 in Toronto. The Director-General gave a keynote address at the 2012 conference while in 2014 the Secretariat gave a presentation and a member of the working group which developed the "Chemistry in Conflict" educational module also gave a presentation. In addition, the Director-General gave a keynote lecture via video at the World Chemistry Congress in Istanbul in August 2013 while the Secretariat participated in a panel discussion and TWG members Alastair Hay and Peter Mahaffy ran an interactive workshop using the "Multiple Uses of

7 Subparagraph 9.131(j) of RC-3/3*.

8 As described by Leiv Sydnes, former President of IUPAC in Leiv Sydnes, "IUPAC, OPCW, and the Chemical Weapons Convention", *Chemistry International*, (July-August) 2013, pp. 4-8.

Chemicals" materials already described. The OPCW supported and participated extensively in the 5th IUPAC International Conference on Green Chemistry in Durban in August 2014, as described in the next section. As suggested by the TWG, the relationship is mutual and IUPAC has briefed the SAB on relevant activities, as well as participating in the international workshop in Vienna in November 2013 and the "Education for Peace" conference in September 2014, both of which are described below.

The relationship with IUPAC will be further formalised at the Nineteenth Session of the Conference of the States Parties in December 2014 when, for the first time, a representative of IUPAC has been invited to address a plenary session of the Conference. If a draft decision on attendance and participation of the chemical industry and scientific community is adopted by the Conference, every future session of the Conference will feature an agenda item dedicated to the chemical industry and the scientific community.

In addition to IUPAC, the OPCW has also established a relationship with the American Chemical Society (ACS) which is the world's largest scientific society and one of the world's leading sources of authoritative scientific information. Each ACS meeting attracts around 15,000 scientists from around the world making the meetings prime engagement opportunities for the OPCW. In late 2014, a representative of the Secretariat attended an ACS meeting in San Francisco on the margins of which the ACS Board of Directors passed a resolution to recognise the OPCW for its work to achieve peaceful applications of the chemical sciences worldwide. Director-General Üzümcü has been invited to give a keynote address at the subsequent ACS meeting in Denver in March 2015. Representatives of the Secretariat will participate in the technical programme of the meeting.

OPCW staff member Farid Tata (right) explains the organisation's work to an attendee of the 44th World Chemistry Congress

The TWG also recommended that the OPCW develop contacts with the International Council for Science (ICSU) which is a non-governmental organisation with a global membership of national scientific bodies (121 Members, representing 141 countries) and International Scientific Unions (32 Members), the latter includes IUPAC. At its second meeting, TWG member Peter Mahaffy noted that Statute 5 of ICSU states that the free and responsible practice of science "requires responsibility at all levels to carry out and communicate scientific work with integrity, respect, fairness, trustworthiness, and transparency, recognising its benefits

and possible harms".[9] The OPCW should work with ICSU in order to engage in the global debate on the responsible conduct of research. Mahaffy also noted the activities of the ICSU Committee for Freedom and Responsibility in the conduct of Science (CFRS).[10] In the context of the Principle of the Universality of Science and the role that it plays in addressing both the freedoms and responsibilities of science and scientists, CFRS has considered how it might address the topic of Science and War. The OPCW should explore possibilities for building synergy with this initiative.[11] A related event is the 4th World Conference on Research Integrity which will take place in Rio de Janeiro from 31 May to 3 June 2015.

Peter Mahaffy also briefed the second meeting of the TWG on the Malta Conferences. These events, of which there have been six to date, are designed to bring together chemists from countries in areas of tension, particularly those from the Middle East. The sixth Malta Conference took place in November 2013 with the OPCW providing sponsorship for some participants and included a presentation by a representative of the Secretariat. The seventh conference will take place in November 2015 in Rabat, Morocco and an OPCW-sponsored workshop on the topic of "sustainability and security" is being considered.

Relations with the Chemical Industry

At its first meeting, the TWG recommended closer links with the chemical industry, particularly with reference to the Responsible Care voluntary initiative which is described in Chapter II, but also in relation to the promulgation of codes of conduct. The TWG also referred to the proposal of the Advisory Panel on Future OPCW Priorities to establish a group of experts from industry.[12] At the third meeting of the TWG, Detlef Männig reported on outreach and awareness-raising in the chemical industry. The most important tools are working groups within chemical industry associations. These teams of experts liaise with National Authorities including law-makers, OPCW-bodies and selected scientific, as well as commercial institutions. They then disseminate information to their member companies via association journals, newsletters and workshops/training activities. Outreach and awareness-raising has largely been limited to those selected partners. There is still concern within the chemical industry that the topic of chemical weapons disarmament is too complex to communicate and would only stir negative sentiments about chemistry in general and the chemical industry in particular.

Reinforcing the message from the TWG, the Third Review Conference adopted several recommendations referring to the chemical industry. For example, the Conference "Encouraged the Secretariat through the National Authorities to continue to strengthen relations with respective national chemical industry. The Secretariat is also encouraged to strengthen its relationship with regional and international chemical industry associations".[13] In response to this recommendation, the Secretariat has continued to engage with the International Council of Chemical Associations (ICCA), which represents chemical manufacturers and producers from around the world and whose full-member associations cover approximately 50% of the facilities declared in accordance with Article VI of Convention. One of the membership criteria for joining the ICCA is support for the CWC. The ICCA also promotes and coordinates the Responsible Care initiative. A meeting between ICCA and the Secretariat took place in September 2013 and several agreed actions have been implemented since then.[14]

In order to institutionalise this relationship, with a view to obtaining a more structured and systematic dialogue between the two organisations, the Director-General has initiated an exchange of letters with the ICCA, defining each party's priorities and responsibilities, as well as the manner in which they will interact. This exchange of letters includes a list of common projects to be continued or initiated among which is

9 See http://www.icsu.org/freedom-responsibility/cfrs/statute-5.

10 For more information on CFRS see http://www.icsu.org/freedom-responsibility/cfrs.

11 See the discussion in SAB-20/WP.1, para 9.2.

12 See paragraphs 45 and 119 of S/951/2011, dated 25 July 2011.

13 See subparagraph 9.79(e) of RC-3/3*.

14 For a more detailed description see in particular paragraph 5 of C-19/DG.14, dated 3 October 2014.

"Outreach and awareness raising to help ensure that chemicals are used only for legitimate purposes". To take these projects forward, the Secretariat has proposed that a "Chemical Industry Coordination Group" be established, consisting of representatives of the Secretariat and the global chemical industry (not limited to the ICCA).

Expanding and Promoting a Culture of Responsibility

The third main objective of the TWG was to report to the SAB on "Proposals for how the OPCW could contribute towards expanding and promoting a culture of responsibility in the scientific community and the chemical industry". In this respect, the recommendations made by the TWG, many of which are already being implemented by the Secretariat, go beyond traditional awareness-raising activities or the strengthening of relationships with other organisations and instead focus on the contribution that a culture of responsibility can make to preventing the re-emergence of chemical weapons. The third meeting of the TWG proposed that the Secretariat "continues to develop more sustained collaborative relationships with relevant actors, such as international organisations, professional associations, civil society, academia etc. in order to expand and promote a culture of responsibility in the scientific community and the chemical industry".[15] The recommendations from the TWG, and the subsequent activities by the Secretariat, involve a wide range of external stakeholders ranging from those closely involved with the OPCW such as National Authorities to those who have not traditionally even been aware of the OPCW such as science centres.

Engagement with CWC National Authorities

The TWG recognised the importance of working with CWC National Authorities at an early stage.[16] In the report of its first meeting, the TWG proposed that education and outreach should be a separate item in the programme of the annual meetings of National Authorities which take place in The Hague. This has been implemented at each annual meeting since 2012. Additionally, in 2012 and 2013 the TWG met in conjunction with the annual meetings and TWG members interacted directly with the National Authorities in break-out sessions. The members briefed National Authority personnel on approaches to take and available tools and materials, and also heard about the challenges faced by National Authorities. The interaction was extremely valuable for both sides.

The important role of National Authorities in education and outreach was acknowledged in a national paper submitted by Argentina in 2013: "National Authorities have a wider role to play in addition to the crucial one given to them by the Convention. They are uniquely positioned to engage and interact with all stakeholders, at the national and international levels, that have responsibilities, interests or obligations related to the use of toxic chemicals. When they work together, they produce synergies that help achieving the goal of the Convention: a world free of chemical weapons, where toxic chemicals and their related technologies and knowledge are used in a safe manner, exclusively for the benefit of mankind".

At its second meeting, the TWG recommended that education and outreach also be included on the agenda of the regional meetings of National Authorities which the Secretariat organises annually.[17] This fed in to the Third Review Conference which, in its final report, recommended that the Secretariat, in concert with the TWG, "assist States Parties, upon request, in implementing education and outreach activities, including by disseminating materials, conducting workshops and regional meetings".[18] The Secretariat has therefore begun to incorporate education and outreach into its existing implementation support programmes. For example, in June 2014, at the Twelfth Regional Meeting of CWC National Authorities in Africa, education and outreach

15 Paragraph 15.1(g) of SAB-21/WP.3, dated 7 January 2014.

16 See for example, paragraph 7.3 of the report of the first TWG meeting, contained in Annex 2 to SAB-18/1, dated 19 April 2012.

17 See paragraph 12(c) of SAB-20/WP.1, dated 25 February 2013.

18 Subparagraph 9.103(e) of RC-3/3*.

appeared for the first time as a parallel workshop session at such a meeting. The session was facilitated by TWG member, Temechegn Engida from Ethiopia. Reflecting the Review Conference's identification of education and outreach as a "relevant activity" for national implementation, the topic has featured on the programmes of subsequent regional meetings of National Authorities during 2014, and on the programme of the Sixteenth Annual Meeting of National Authorities in November 2014.[19] Several States Parties have now volunteered to launch pilot national education and outreach projects which will be supported by the Secretariat. Such pilot projects should make extensive use of the materials described in this report.

Members of the TWG meet with members of National Authorities

Given the wider role for National Authorities identified by Argentina, future OPCW regional meetings with education and outreach on the agenda should always involve participation by academics and chemists who would be interested in pursuing activities after the meetings and who can then work together with the National Authority at the domestic level. Participation by officials from ministries of education in such meetings will be equally important.

The Argentine Project on Education and the Chemical Weapons Convention

In 2010 the Argentine National Authority initiated several national activities as part of the next stage in the implementation of the Chemical Weapons Convention in Argentina. These activities included the establishment of a Working Group to study outreach and dissemination of the obligations under the Convention and the national legislation that implements it.

A subsequent outreach campaign conducted in 2011 and 2012 identified a large number of companies that were not registered with the National Authority. In parallel, during several inspections to declared sites, the National Authority noticed that even well-educated and trained senior facility managers had an incorrect or incomplete understanding of the technicalities of the Convention and the national implementation norms. The individuals acknowledged that they had not received adequate information during their university studies about the national legal requirements and obligations of the Convention.

This showed that the information campaign run by the National Authority for the private sector was not sufficient and that other ways had to be devised to improve the level of technical knowledge among students of chemistry, chemical engineering and other related careers who would eventually manage declared chemical plants.

19 C-18/NAT.3, dated 2 December 2013, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=16910.

Significantly, the Working Group considered that the subject was too important to be circumscribed to only providing a better understanding of the obligations of the Convention to future managers of declarable facilities. As described in an Argentine national report submitted to the Eighteenth Session of the Conference of the States Parties: "The Group therefore proposed a broader scope for the project, in order to promote a culture, among all professionals in the chemical fields, of the responsible use of technical and scientific knowledge, in order to be aware of the potential danger and to prevent all misuse and abuse of chemicals".[20] It was proposed that the project should also include practicing chemists, research scientists and university laboratory professionals and the group also considered that, at a second stage, the project should be targeted to secondary level students.

Given the federal nature of the Argentine university system, the Argentine National Authority, based in the Ministry of Foreign Affairs, sought the support of the Ministry of Education. Both ministries agreed to work together and signed a Memorandum of Strategic Cooperation in August 2013, which established the goals and actions to implement a "National Project on Education on the Responsible and Secure Use of the Chemical Sciences and Technologies for the Scientific, Economical and Social Development of the Argentine Republic". This partnership between the National Authority and the Ministry of Education has been key to the success of the Argentine national project.

The project consists of four main elements:[21]

1. An overarching "Network of Networks" coordinated by the National Authority and the Ministry of Education which holds annual meetings;

2. A "Train-the-Trainers" Programme Coordinated by the National University of Rosario and the Southern National University (Bahía Blanca). A first workshop was held in Rosario in June 2013 and a second will be held in Bahía Blanca in November 2014;[22]

3. A Virtual Classroom coordinated by the Kennedy University with the National University of Lomas de Zamora. Approved on-line content will be made available to all participating universities;

4. A Travelling Class coordinated by the National University of Córdoba with the intention of conducting outreach to faculties where there are no educational tools or trained personnel yet.

In December 2013, the paper submitted by the Argentine National Authority reported "great interest" in the project from professors and students. The same paper also said that another report would be submitted to the Nineteenth Session of the Conference of the States Parties in December 2014, measuring implementation of the project against a number of well-chosen indicators. The Secretariat has now started working with several States Parties which have expressed an interest in developing national action plans on education and outreach.

In addition to the activities to implement the project nationally, the Argentine National Authority has also been keen to share the experience gained in implementing the national project with its Latin American and Caribbean counterparts and with other interested stakeholders from further afield. In this regard, in April 2014 the Secretariat, together with the Government of Argentina, co-organised the First Regional Meeting on Education in the Responsible Application of Knowledge of Dual-Use Chemicals. The meeting was attended by representatives of 44 National Authorities and universities from 22 States Parties in the region and also by TWG member Alastair Hay. The results of the meeting are described in a national paper which Argentina

20 C-18/NAT.3, dated 2 December 2013, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=16910.

21 For a comprehensive description of the national project, see the presentation by the Executive Chairman of the Argentine National Authority at http://www.opcw.org/index.php?eID=dam_frontend_push&docID=17818.

22 For more information on the June 2013 workshop in Rosario, see Alejandra Suarez and Rolando Spanevello, "Projects in Education and Outreach Relevant to the CWC: A Pilot Activity in Argentina", *OPCW Today*, Vol. 2, No. 5 (December 2013), pp. 27-28, available at https://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_2_No_5.pdf.

submitted to the Executive Council at its Seventy-Sixth Session.[23] The meeting has served as a model and the draft OPCW programme and budget for 2015 includes funding for two further such regional meetings in 2015, likely in Africa and Asia.

The First Regional Meeting on Education in the Responsible Application of Knowledge of Dual-Use Chemicals in Buenos Aires

Codes of Conduct

Codes of conduct are frequently seen as an important tool in promoting and reinforcing a culture of responsibility within the scientific community to support non-proliferation and disarmament.[24] The 2005 OPCW/IUPAC workshop already included a discussion of codes and led to an effort to develop a code for IUPAC.[25] More recently, the issue of *OPCW Today* devoted to education and outreach included an article that addressed the contributions of codes of practice in the chemical industry.[26] These examples illustrate that there are different varieties of codes that serve different purposes, such as:

- Aspirational codes (often designated as 'codes of ethics') set out ideals that practitioners should uphold, such as standards of research integrity, honesty, or objectivity.
- Educational/Advisory codes (often designated as 'codes of conduct') would go further than merely setting aspirations by providing guidelines suggesting how to act appropriately.
- Enforceable codes (often designated as 'codes of practice') seek to further codify what is regarded as acceptable behaviour. Rather than inspiring or educating in the hopes of securing certain outcomes, enforceable codes are embedded within wider systems of professional or legal regulation.[27]

23 See EC-76/NAT.1, dated 5 June 2014, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=17492.

24 The 2005 intersessional process of the Biological Weapons Convention, for example, was devoted to the "content, promulgation, and adoption of codes of conduct for scientists." Many of the materials developed for the meeting, which may be found at http://www.unog.ch/80256EE600585943/(httpPages)/DA292636AE31F1CBC125718600361E55?OpenDocument, remain relevant to current discussions.

25 Graham S. Pearson, Edwin D. Becker, and Leiv K. Sydnes, "Why Codes of Conduct Matter", *Chemistry International*, Vol. 33, No. 6, (November-December 2011), available at http://www.iupac.org/publications/ci/2011/3306/2_pearson.html.

26 Aaron C. Gluck, "How Codes of Practice Enhance a Chemical Security Culture," *OPCW Today*, Vol. 2 No. 5, (December 2013), pp. 18-21, available at https://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_2_No_5.pdf.

27 Brian Rappert, *Towards a Life Sciences Code: Countering the Threats from Biological Weapons* Bradford Briefing Papers (2nd

At the second meeting of the TWG, Jo Husbands introduced a survey of codes of conduct from professional chemistry societies and ethics codes from trade associations, industry, government and academia. Of the 40 codes surveyed, only one clearly stated that members cannot provide materials or expertise to create a chemical weapon. While others had language about ethics, safety and environmental responsibility, only two referred specifically to security practices and principles. Detlef Männig circulated examples of several codes of conduct from professional associations and the chemical industry. TWG members agreed that incorporating reference to the Convention into existing and new chemistry codes of conduct could be a mechanism for increased outreach, and should therefore be explored further. The discussions within the TWG also emphasized the utility of codes in educational settings and that the process of creating a code together is an important learning opportunity. The TWG ultimately did not undertake projects related to codes during its mandate but the recommendations should be considered as part of new education and outreach activities.

The topic of codes of conduct is once again gaining in prominence with the introduction by the German delegation at the Forty-Sixth Meeting of the Executive Council in November 2014 of a proposal for the drafting of a "new ethical and moral guideline for chemists".

Broadening the Message to Engage New Audiences

While supporting new ways of interacting with traditional partners such as the National Authorities, the TWG also made recommendations for innovative approaches and for engagement with new audiences. In addition, the TWG noted that the unique constellation presented by the 2013 Nobel Peace Prize, the centenary of the First World War, the approaching centenary of the first large-scale use of chemical weapons, the use of chemical weapons in Syria and subsequent accession of Syria to the Convention presents an unparalleled opportunity for OPCW.

The OPCW Director-General delivers a keynote speech at the annual conference of the European Network of Science Centres and Museums

series) No. 13, (2004), http://www.bradford.ac.uk/acad/sbtwc/briefing/BP_13_2ndseries.pdf, pp.14-17.

From its first meeting, the TWG has encouraged the identification of "champions", prominent individuals who can attract the attention of large audiences. The TWG has also encouraged the Director-General to take on a role as a "messenger" for the OPCW's education and outreach activities. With the award of the Nobel Peace Prize for 2013 to the OPCW, the Director-General has been able to engage with a much wider range of audiences than previously. For example, in 2014 he was invited to give keynote speeches at the annual conference of the European Network of Science Centres and Museums (ECSITE) in The Hague and at the EuroScience Open Forum in June in Copenhagen. Also in June 2014, the OPCW hosted the "Day of Excellence" for science at higher education institutions in the Netherlands which was attended by the Dutch Minister of Education, Science and Culture. When travelling on official visits, the Director-General has requested to meet with ministers of education and science in order to inform them of the OPCW's activities. Based on the experience in Argentina, the TWG believes that engaging ministries of education is an important element in developing and sustaining activities at the national level.

Recent articles on the OPCW in publications of the chemical science community

The Secretariat has also expanded its engagement at the technical level, particularly through the activities of the Science Policy Adviser and the OPCW Laboratory, and its publications. The Science Policy Adviser has made presentations at scientific conferences around the world in order to raise awareness about the OPCW and to encourage new partnerships. He has also authored or contributed to several publications in journals published by international and national chemical associations while OPCW Laboratory staff edited a special issue of the journal *Analytical and Bioanalytical Chemistry* to which a member of the TWG and his colleagues contributed articles.[28] Secretariat staff have also organised information booths at the IUPAC meetings in Istanbul and Durban and at the ECSITE conference in The Hague. The December 2013 issue of the OPCW journal, *OPCW Today*, was dedicated to education and outreach and included articles describing relevant activities around the world. Just recently, the Secretariat has begun to publish a series of fact sheets which provide basic information about the OPCW and the CWC.[29]

28 Marc-Michael Blum and R. V. S. Murty Mamidanna (eds.), Special issue of *Analytical and Bioanalytical Chemistry*, "Analysis of Chemicals Relevant to the Chemical Weapons Convention", Vol. 406, No. 21 (August 2014), available at http://link.springer.com/journal/216/406/21.

29 To date, four such fact sheets have been issued, and they are available at https://www.opcw.org/documents-reports/fact-sheets/.

At its third meeting, the TWG received a briefing from Friso Visser, the deputy director of Museon, a large museum for culture and science located very close to the OPCW headquarters building. Museon was established in 1906 and today has a total exhibition space (temporary and permanent) of 4,000m^2. In 2012, Museon received approximately 193,500 visitors, including 42,500 school students. Museon is also a founding member of the European Network of Science Centres and Museums (ECSITE) and hosted the 25th ECSITE annual conference in The Hague in May 2014 in which the OPCW participated. Mr Visser explained the development of science centres and their role in formal and informal learning. During 2014, Museon has been showing an exhibition on the neighbouring international organisations which prominently features the OPCW. In addition, as it does with every Nobel Peace Prize winner, the Nobel Peace Center in Oslo developed and displayed an exhibition on the OPCW. The Secretariat has interacted with both Museon and the Nobel Peace Center and plans to develop its own travelling exhibition on the OPCW for use at relevant events in 2015 and beyond.

Connecting the Dots and Maintaining Visibility

In order to connect all these different activities and to form networks among the organisations involved, from 22-23 September 2014 the OPCW hosted an international conference entitled "Education for Peace: New Pathways for Securing Chemical Disarmament".[30] The conference brought together some 120 experts from government, science, industry, academia and civil society from more than 40 countries to exchange information on improving education and outreach in disarmament and non-proliferation, and to discuss ways in which to sustain activities and initiatives in this area. The experts included members of the SAB and the TWG.

In opening the conference, the Director-General noted that, "We need to reach more people more effectively – not only to help them understand how disarmament contributes to international peace and security, but also to empower them as stakeholders in this common venture". Director-General Üzümcü outlined the range of activities undertaken by the OPCW and launched the OPCW's resource centre for students and teachers.[31]

Twelve panels were organised over the two days of the conference covering the following subjects:

1. Working with Multiple Stakeholders: Collaboration with Universities and Academic Networks
2. International Organisations: Sharing Experience and Best Practices
3. Professional Training and Capacity Development: Educating the Next Generation of Officials and Experts
4. Reaching Students and the Need for a Multidisciplinary Approach
5. Responsible Science: Ethical Standards for Scientists
6. Creating Links in the Curriculum: Integrating Peace and Disarmament into Related Subjects
7. Developing the Right Educational Tools and Materials
8. Innovative Techniques: Active Learning, Role Plays, Simulations and Other Tools
9. Broadening the Audience: Working with Science and Peace Centres and Museums

30 The conference programme and presentations are available at http://www.opcw.org/education-and-outreach-conference/programme/.

31 See http://www.opcw.org/our-work/education/.

10. Maximising Events: The Nobel Peace Prize and the Centenary of the First Use of Chemical Weapons

11. Building and Sustaining Lasting Collaborations Between Multiple Stakeholders

12. The National Experience: Programme and Challenges

During the conference, the OPCW also hosted a simulation organised by the Student Amsterdam Model United Nations in order to engage with a key target audience and to demonstrate the use of simulations as an educational tool. Several visual and other resources were also showcased, such as the "Fires" film project, the OPCW's e-learning tools and a reading from a play about the use of chemical weapons during the First World War.

One outcome of the conference is the OPCW Education Network which will shortly be established to sustain the contacts made and discussions held during the conference.

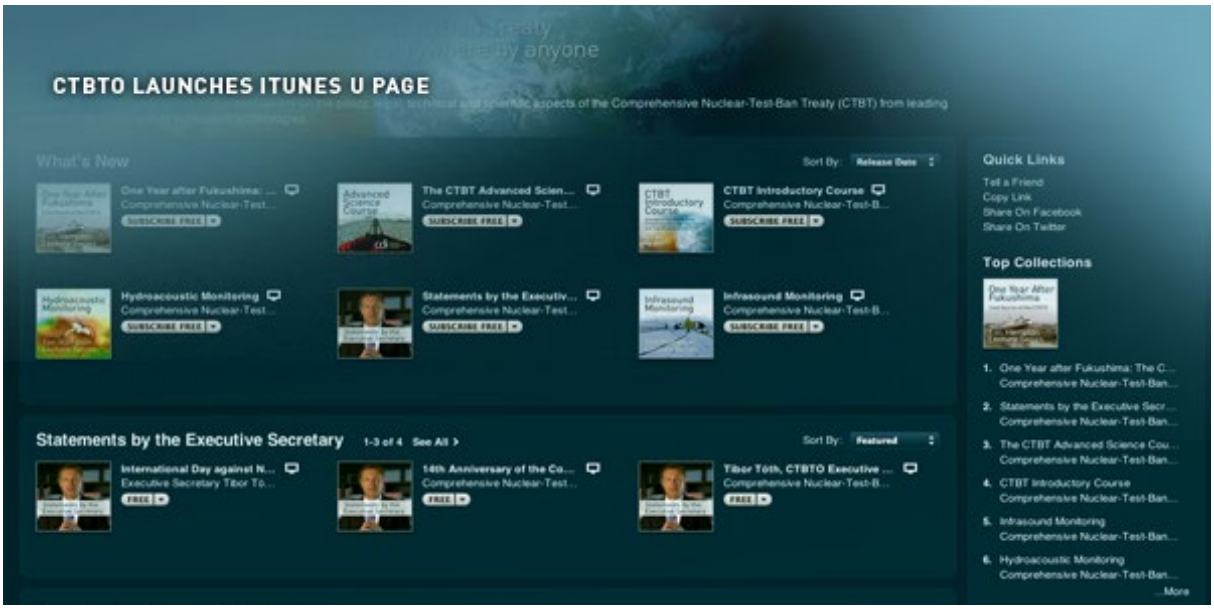
Opening Plenary of Education for Peace: New Pathways for Securing Chemical Disarmament

Building Relationships

An important part of the TWG's mandate was to identify existing initiatives, both in order to explore potential cooperation and avoid duplication of effort. Previous sections have described those efforts in relation to professional societies, academia and industry. This section focuses on other international security organizations. As described in the Context chapter, education and outreach have become significant elements in the programmes of all the major non-proliferation and disarmament organizations, as well as in efforts to address WMD challenges comprehensively such as the increasing interest in CBRN safety and security culture. As part of its meetings, the TWG heard briefings about the work of other organizations. In the case of the Biological Weapons Convention (BWC), where the convergence of chemistry and biology make the questions of potential synergies especially relevant, OPCW staff and TWG members took part in side events during BWC meetings.

Comprehensive Nuclear Test-Ban Treaty Organisation (CTBTO)

Jean du Preez and Ryan Gonzalez from the CTBTO presented the Capacity Development Initiative (CDI) and demonstrated its e-learning tools.[32] Launched in 2010, the CDI is a key element of the CTBTO's training and education activities. The Initiative is focused on building and maintaining the necessary capacity in the technical, scientific, legal and political aspects of the Treaty and its verification regime. Through live lecture courses by Commission staff and top experts, and a robust e-learning platform, CDI promotes the active engagement with the current and next generation of CTBT experts. In addition, Mr du Preez said that a network of global partnerships with academic and research institutions is being established that represents mass educational outreach and collaboration. This provides the opportunity for integration of CDI modules into university curricula, further expanding and sustaining the pool of CTBT expertise.



CTBTO courses available on iTunes U (CTBTO)

By leveraging cutting edge technologies such as an open-source learning management system, social media, collaboration technologies and iTunes U, Mr du Preez said that the CDI has the potential to reach beyond the traditional pool of stakeholders. Further collaboration with international organizations, especially the OPCW, could result in a "one stop shop" culminating in a comprehensive disarmament curriculum. He believed that the lessons learned to date from utilizing e-learning platforms and education activities between the various organizations are very useful and should be further explored.

International Atomic Energy Agency (IAEA)

Andrea Braunegger-Guelich from the IAEA briefed the TWG on the nuclear security education programmes of the IAEA. The presentation covered several topics including: What nuclear security is and why the international community is concerned about it; International instruments for nuclear security; Objectives of the IAEA Human Resource Development Programme; Nuclear Security Training Programme; IAEA Efforts supporting Nuclear Security Education; and how the IAEA collaborates with the academic and scientific community through the International Nuclear Security Network (INSEN). Ms Braunegger-Guelich highlighted several areas of potential commonality between the initiatives of the IAEA, the OPCW and other international organisations, including teaching approaches; development of faculty members; development of stimulating teaching materials; faculty exchange; evaluation methods; and ways in which to bring educators together with subject matter experts.

32 For more information, see Jean du Preez, "Outreach Through Education for the Entry Into Force of the Comprehensive Nuclear-Test-Ban Treaty", *OPCW Today*, Vol. 2, No. 5 (December 2013), pp. 39-40, available at https://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_2_No_5.pdf.

United Nations Educational, Scientific and Cultural Organisation (UNESCO)

Dr Rovani Sigamoney from UNESCO described that the organisation's education initiatives in the fields of science and engineering. She described how UNESCO is encouraging the development and/or integration of innovative, interesting and dynamic tools and methodologies into science teaching in order to capture the interest of young students. Emphasis is being placed on enquiry based investigation and hands-on teaching methodologies as a means of improving science curricula. She referred to the numerous chemistry educational activities that were launched and supported during the International Year of Chemistry in 2011 and informed the TWG that 2014 will be the International Year of Crystallography, which could involve opportunities for collaboration with the OPCW.

EU CBRN Centres of Excellence

Dr Daan Noort and Dr Stephanie Meulenbelt of TNO Laboratories in the Netherlands informed the TWG on the experiences of TNO in building and maintaining networks to the scientific community. Under the EU CBRN Centres of Excellence initiative, TNO participates in a project entitled "Network of Universities and Institutes for Raising Awareness on Dual-use Concerns of Chemical Materials". The Project aims at contributing to the safety and security of chemical dual-use materials and processing equipment, via the reinforcement of chemical safety and chemical security, a culture of responsibility and the awareness and engagement of both expert and young chemical scientists. The project foresees three key activities: organisation of national expert networks (in Central Asia; South East Europe, the Caucasus, Moldova and Ukraine; Middle East; North Africa and South East Asia); organisation of workshops and training events; and provision of relevant documentation to the trainees. Within the project consortium, TNO leads on the third activity with the aim of producing materials to recognise the issue of dual-use chemicals, increase awareness on dual-use of chemicals, cultivate responsibility regarding dual-use possibilities, promote the discussion on suitable countermeasures at the workplace and create a basis for future institutional courses on dual-use issues.

Biological Weapons Convention (BWC)

As shown by the results and recommendations flowing from the TWG on the convergence between chemistry and biology,[33] there are particular reasons for the OPCW to pay attention to developments with regard to the BWC.[34] The BWC provides the opportunity for side events during both its Meetings of Experts and Meetings of States Parties, and these have provided an opportunity to inform participants in those meetings about OPCW's education and outreach activities.[35] In addition, science and technology topics connected to the BWC also link with themes being considered in the ongoing work of the SAB and its temporary working groups. Opportunities for the OPCW to expand its scientific networks beyond those focusing on convergence have been identified within the BWC community and maximising these will be important for collecting input to the report on developments in science and technology which the SAB will prepare leading up to the Fourth CWC Review Conference in 2018.

- A joint side event, "OPCW Scientific Advisory Board Temporary Working Groups on the Convergence of Biology and Chemistry and on Education and Outreach", provided additional opportunities to bring information about education and outreach activities to the participants in the Meeting of States Parties in December 2012. SAB chairperson Stefan Mogl and TWG member Jo Husbands both gave presentations.

33 OPCW, *Convergence of Chemistry and Biology: Report of the Scientific Advisory Board's Temporary Working Group*, June 2014, available at http://www.opcw.org/news/article/opcw-scientific-advisory-board-issues-report-on-the-convergence-of-chemistry-and-biology/.

34 For more information on education and outreach activities within the BWC, see Jamie Revill, "Education and Outreach Activities within the Biological Weapons Convention", *OPCW Today*, Vol. 2, No. 5 (December 2013), pp. 42-43, available at https://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_2_No_5.pdf.

35 Further information may be found under "Side Events" as part of the material for each meeting on the BWC website http://www.unog.ch/80256EE600585943/(httpPages)/92CFF2CB73D4806DC12572BC00319612?OpenDocument.

- During the Meeting of Experts in August 2013, the OPCW and the BWC Implementation Support Unit organized a joint event entitled "Convergence of biology and chemistry and opportunities for outreach and education – OPCW and BWC ISU". A TWG member, Stefan Mogl from Switzerland, gave a presentation about the activities of the TWG on convergence, and SAB Chairperson Alejandra Suarez presented the initial results of the pilot project in Argentina.

- At the Meeting of States Parties in December 2013 TWG member Jo Husbands from the USA provided an update on the TWG's activities, emphasizing the lessons that the two conventions might learn from each other. The OPCW's Science Policy Adviser took part in a side event on developments in science and technology during the same meeting.

In November 2013, the Secretariat and the Vienna Center for Disarmament and Non-Proliferation (VCDNP) organised an "International Workshop on Disarmament and Non-Proliferation Education and Capacity Development" in Vienna.[36] The workshop was supported financially by the Foreign and Commonwealth Office of the United Kingdom and the Federal Ministry for European and International Affairs of Austria. It brought together practitioners in the field of disarmament and non-proliferation education, particularly from the international organisations listed above, as well as experts from selected leading academic centres and professional networks. The workshop provided an opportunity for this broad range of professionals to share experiences and best practices—particularly with regard to specific tools and methods—and to explore potential collaboration and synergies between international organisations and other key stakeholders in the areas of disarmament and non-proliferation education and training, awareness-raising and outreach. Workshop participants made recommendations under three main headings: Improving and increasing contacts and communication among relevant organisations, including international organisations, non-governmental organisations and academia; increasing project cooperation to maximise efficiencies, decrease duplication of efforts, and avoid gaps; and raising the profile of disarmament and non-proliferation education.

36 A summary report of the workshop is available at: http://www.vcdnp.org/131125_np_education_workshop_report.htm and further information is available in Elena Sokova and Daniel Feakes, "Facilitating and supporting synergy and collaboration between international organisations", *OPCW Today*, Vol. 2, No. 5 (December 2013), pp. 37-38, available at https://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_2_No_5.pdf.

IV. Recommendations of the Temporary Working Group

Recommendations Regarding Sustainability of OPCW Education and Outreach Efforts

Based on the work of the TWG as described in the preceding chapters, the members of the TWG would like to submit the following recommendations for the consideration of the SAB, the Director-General and the States Parties:

Recommendation 1: Education and outreach with respect to the responsible use of science, particularly as it is relevant to the Chemical Weapons Convention, should remain a core activity of the OPCW, so as to achieve and maintain a world free of chemical weapons.

The OPCW's education and outreach work should receive increasing visibility; be sufficiently resourced and supported. It should also be able to adapt to reflect decisions about how the mandate and activities of the OPCW will adjust to the "highly dynamic environment" resulting from the rebalancing of the OPCW's core objectives over the 2015-2019 period of the Medium Term Plan.

> *Supporting Evidence:* The education and outreach mandate for the OPCW was clearly set out in the terms of reference for the TWG, and reinforced and strengthened in the final report of the Third Review Conference and in the Medium Term Plan for 2015 - 2019. Strategic opportunities for enhanced education and outreach with respect to the responsible use of science, particularly as it is relevant to the CWC, have resulted from events such as the awarding of the Nobel Peace Prize in 2013 and the upcoming centenary of the large scale use of chemical weapons in the First World War in 2015. In anticipation of the centenary, increased requests for information about chemical weapons and the Convention are coming to the OPCW and other stakeholders and more are expected to come as the events approach.

Recommendation 2: The OPCW's education and outreach activities with respect to the responsible use of science, particularly as it is relevant to the CWC, should be guided by evidence-based science education and communication practices, so as to support the goal to achieve a world free of chemical weapons and to prevent the re-emergence of chemical weapons.

This implies, among other things:

- *Clarity about the purpose of that education or communication* (e.g., to distinguish among education or communication about the OPCW as an organization, about chemical weapons and the CWC, about disarmament, or about responsible practices and cultures of science that will prevent re-emergence of chemical weapons);

- *Identification of the target audiences for education or communication* (e.g., National Authorities, inspectors, students and/or teachers in formal school settings, scientific professions, chemical industry, media, partner organizations, stakeholders or other publics that might be effectively reached with information about the OPCW's work);

- *An understanding of active learning strategies and other practices* that research literature shows to be effective in education and communication.

Supporting Evidence – Target Audiences and Purpose of Communication: The OPCW can helpfully draw on the experience of other science-based organizations that have carefully considered effective practices in identifying target audiences for education and communication, and also analysed the purposes for education or communication to their different target audiences and "publics". A particularly helpful exemplar may be the technical report issued by an IUPAC task force that carried out a survey of the research literature and made recommendations intended to bring the same level of intellectual rigour to IUPAC's science communication activities as to its scientific activities.[1]

Supporting Evidence – Active Learning Strategies and Effective Pedagogies: Substantial evidence is found in the science education research literature about the effectiveness of moving from teacher-centred to learner-centred environments, and the importance of engaging learners with active learning pedagogical strategies that respect and understand the prior experiences and understandings that can help learners build bridges to new understandings.

Recommendation 3: An ongoing expert advisory group on education and outreach with respect to the responsible use of science, particularly as it is relevant to the CWC, should be established to help OPCW fulfil its mandate for education and outreach, and to ensure that activities and practices are grounded in science education and communication research findings and effective practices.

The expert advisory group should be placed in the OPCW organizational structure to enable it to carry out its mandate effectively across programme areas.

Such an expert advisory group could be established under Article VIII, subparagraph 21(f) of the Convention which states that the Conference of the States Parties shall "Establish such subsidiary organs as it finds necessary for the exercise of its functions in accordance with this Convention".

Supporting Evidence: (a) The OPCW's education and outreach activities must be evidence-based, just as is the case for its science activities. The expert advisory group should bring the expertise to fulfil this function, just as the SAB provides specialized advice on science and technology to the OPCW. (b) The substantial output of education and outreach activities and projects of the TWG demonstrate the value brought to the OPCW by tapping the expertise of members of a group such as this as well as the organizations and networks they represent. The proposed expert advisory group, consisting of volunteer education and other specialists can multiply the scale and impact of education and outreach activities achievable by the OPCW. (c) The recommendation that the expert advisory group should be an ongoing, rather than a temporary group, is in keeping with the mandate of the TWG to report to the SAB on how to ensure the sustainability of education and outreach activities once the TWG completes its work.

Recommendation 4: The core mandate for the expert advisory group should be:

- To advise the Director-General on matters related to education and outreach, which are embedded in each of the core activities of the OPCW;
- To advise and support the education and outreach work carried out by OPCW staff members, National Authorities and States Parties, and activities at regional and national levels;
- To maintain a portfolio of education and outreach activities and projects, to validate material that has been developed and to advise on how to make it accessible to target audiences;

1 Peter Mahaffy, Anthony Ashmore, Robert Bucat, Choon Do and Megan Rosborough, 2008, "Chemists and the Public: IUPAC's Role in Achieving Mutual Understanding (IUPAC Technical Report)", *Pure and Applied Chemistry*, Vol. 80, No. 1, pp. 161-174, available at http://pac.iupac.org/publications/pac/pdf/2008/pdf/8001x0161.pdf.

- To monitor global education and outreach activities related to responsible uses of science, particularly those relevant to the CWC; and

- To develop informal and formal partnerships with international organizations and other stakeholders working in areas related to the OPCW's education and outreach mandate.

Supporting Evidence: In arriving at this recommendation for the core mandate for the expert advisory group, the TWG was informed by the somewhat parallel experience of IUPAC in establishing the terms of reference for its Committee on Chemistry Education.

Recommendation 5: In the appointment of the expert advisory group with respect to the responsible use of science, particularly that relevant to the CWC, individuals with expertise in areas such as the following should be included: science education (particularly chemistry), disarmament and non-proliferation education, science communication, chemical industry, and dual/multiple use issues related to chemistry and the biological sciences.

It would be helpful to include representation by the SAB to ensure that the educational material reflects current developments in science and technology relevant to the OPCW. The work of the expert advisory group will need the support and guidance of the Technical Secretariat, including its expertise in the area of media and public affairs.

Supporting Evidence: Expertise in these areas is needed to ensure the credibility and research base of the interdisciplinary education and outreach work of the OPCW, and to create appropriate linkages with other partners to more effectively and efficiently carry out that work.

Recommendation 6: The expert advisory group will develop its own education and outreach strategies, short and long term priority target audiences, informal and formal collaborations and partnerships, and activities and materials.

Supporting Evidence: The expert advisory group should be tasked with developing its own strategies, priority targets, collaborations, and activities. However the TWG, before its mandate is completed, should work with others in the Technical Secretariat to more fully develop the detailed terms of reference of the new expert advisory group.

Recommendation 7: Until such time as the expert advisory group is appointed, the current TWG should continue its work.

Supporting Evidence: It is crucial that momentum on education and outreach for the OPCW is not lost, particularly in light of major strategic opportunities such as the receipt of the 2013 Nobel Peace Prize, removal and destruction of chemical weapons in Syria and the 2015 centenary of the first large scale use of chemical weapons in the First World War. Its terms of reference state that the TWG will exist for three years from the date of its first meeting. The first meeting was in April 2012. The terms of reference go on to state that the TWG's work will be reviewed by the SAB and the Director-General at the three-year stage and a decision will be made as to whether it should continue its work and whether the Terms of Reference should be revised.

Additional Recommendations

The TWG submits the following six additional recommendations for consideration by the SAB, the Director-General and the States Parties:

8. Chemical weapons issues are best introduced in formal education contexts through the "Multiple Uses" approach, so as to emphasize that most chemicals are beneficial. Beneficial substances, however, can be misused and abused, and education and outreach with respect to the responsible use of science is a helpful framework to ensure that chemicals are used responsibly and that chemical weapons are not created.

9. To enhance the impact of the work on education and outreach the Technical Secretariat and National Authorities should reach out to national ministries of education and to the networks of national academies of science at the regional and global level. As demonstrated by the success of the Argentine national project on education and outreach, collaboration between the National Authority and the ministry of education is crucial for sustained engagement with the national education sector. The TWG welcomes the efforts by the Director-General to reach out to ministers of education during his official visits to States Parties. Going forward, it will be important to encourage participation by officials from ministries of education in the proposed regional meetings on education and outreach. Regional and global networks of national academies of science are also important partners in achieving the greatest impact of efforts on education and outreach.

10. The OPCW should work with IUPAC's Committee on Chemistry Education to develop one or more joint projects that use the problem of chemical weapons as rich contexts to introduce topics for education at different levels. This can be done in cooperation with groups working on Responsible Research and Innovation, Responsible Care and Ethical Issues in Science. Priority might be given in the next year to developing rich contexts for teaching core organic, analytical, and biochemistry topics at the post-secondary level. A substantial barrier to implementation of education about chemical weapons in formal science education contexts is the constraint of over-crowded curricula. One approach to overcoming this challenge which has support in science education research, is to introduce core chemistry concepts through a motivating and interesting rich context. Chemical weapons provide a particularly relevant context during the period of time that the world's attention is focused on the centenary of the first large scale use of chemical weapons in the First World War.

11. Accurate information about chemical weapon related issues, including precursors, destruction, decontamination and detection of chemical weapons should be provided by OPCW, as the organization that has most of the information and that is seen as the most credible source of information on issues associated with chemical disarmament, and the non-re-emergence of chemical weapons. Details on protective measures and medical treatments might also be incorporated. The need for this information is particularly pressing, given the upcoming centenary of the first large scale use of chemical weapons in the First World War, and the requirement for accurate information for use by students and teachers, the media and the public. The TWG recommends that a project group be formed to create an entry containing this information both in Wikipedia and on the website of OPCW. It has been reported to the TWG that some of the information on chemical weapons disarmament on the OPCW website could be more accessible, interestingly presented and informative for these audiences.

12. For the centenary activities surrounding the commemoration of the first large scale use of chemical weapons in the First World War, the OPCW should develop, in partnership with schools, perhaps starting with schools in the Ieper area, an educational project on the use of chemical weapons and the CWC. The project could be presented during the official commemoration ceremony, and could be used by other schools around the world. The TWG could advise on the establishment of the project.

13. In the event that the recommendations for the appointment of an expert advisory group are approved, but cannot be implemented soon enough to avoid a loss of momentum in education and outreach activities, a meeting of the TWG should be held in 2015. One logical (and desirable)

opportunity for such a meeting would be to hold it in conjunction with the Centenary events in Ieper in April 2015. This would make it possible for the TWG to contribute to educational activities around the centenary commemoration, meet in person to more fully develop the terms of reference of the on-going expert advisory group on education and outreach and maintain momentum on the projects initiated since the fourth TWG meeting in September 2014, and to invite partners and stakeholders in the future education and outreach work of OPCW that might be in reasonable proximity (such as those located in Brussels) to meet with the TWG for fruitful discussion on how to support of the aim of a "world free of chemical weapons".

The Nobel Peace Center uses the OPCW to teach students about peace (Johannes Granseth/Nobel Peace Center)

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"Note by the Director-General: Engaging the Chemical Industry Associations", C-19/DG.14, dated 3 October 2014.

Annex I

Members of the Temporary Working Group on Education and Outreach in Science andTechnology Relevant to the Chemical Weapons Convention

Member	Institution
Apotheker, Jan	University of Groningen, the Netherlands
Balali-Mood, Mahdi	Medical Toxicology Centre, Imam Reza Hospital, University of Medical Sciences, Mashhad, Islamic Republic of Iran
Benachour, Djafer (Chair)	Ferhat Abbas University, Ministry of Higher Education and Scientific Research, Setif, Algeria
Coleman, Philip	Protechnik Laboratories, South Africa
Engida, Temechegn	Addis Ababa University, Ethiopia
Hay, Alastair	University of Leeds, United Kingdom of Great Britain and Northern Ireland
Husbands, Jo	National Academy of Sciences, Washington, D.C., United States of America
Mahaffy, Peter	The King's University College, Edmonton, Canada
Mathews, Robert	Defence Science and Technology Organisation, Melbourne, Australia
Männig, Detlef	Evonik Industries AG, Germany
Mogl, Stefan	Spiez Laboratory, Switzerland
Soon, Ting-Kueh	Malaysian Institute of Chemistry, Kuala Lumpur, Malaysia
Suárez, Alejandra Graciela	Universidad Nacional de Rosario and Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina
Timperley, Christopher	Defence Science and Technology Laboratory, Porton Down, United Kingdom of Great Britain and Northern Ireland

Annex 2

Guest Speakers at Meetings of the Temporary Working Group on Education and Outreach in Science and Technology Relevant to the Chemical Weapons Convention

Speaker	Institution
First Meeting	
Jean du Preez	CTBTO
Ryan Gonzalez	CTBTO
Andrea Braunegger-Guelich	IAEA
Second Meeting	
Masamichi Minehata	University of Bradford, United Kingdom
Third Meeting	
Dr Friso Visser	Museon, The Netherlands
Dr Stephanie Meulenbelt	Netherlands Organisation for Applied Scientific Research (TNO)
Dr Rovani Sigamoney	UNESCO
Professor Ludo Juurlink	Leiden University
Dr Daan Noort	Netherlands Organisation for Applied Scientific Research (TNO)
Fourth Meeting	
Lynn Grey	Leadership in International Management

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Above: Children learn about chemistry at the OPCW during A Peace of Art event in May 2014.

Front cover: Visitors hear a presentation on chemical agent detection equipment on The Hague International Day 2012.

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