

Science For Diplomats at CSP-24 Presents:

# The Return of the Chemical Mystery



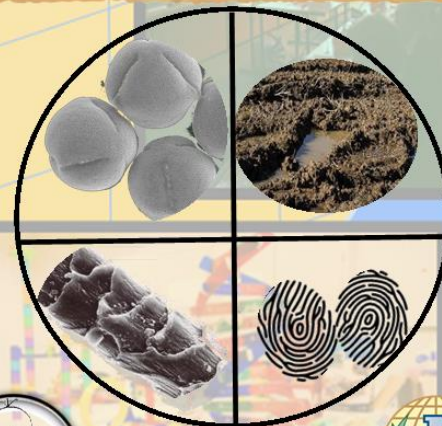
The inspectorate joins us to take you on a chemistry mission guided with advice from the Temporary Working Group on Investigative Science and Technology

**Wednesday 27 November 2019**

**13:15-14:45**

**Europe Room, World Forum**

**Light Lunch available at 13:00**



OPCW





# ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Working Together For a World Free of Chemical Weapons

## Temporary Working Group on Investigative Science and Technology

Reporting to the Scientific Advisory Board (SAB), the Temporary Working Group (TWG) will in particular consider the following questions:

### Question 1:

Which methods and capabilities used in the forensic sciences could usefully be developed and/or adopted for Chemical Weapons Convention-based investigations?



### Question 2:

What are the best practices and analysis tools used in the forensic sciences for effectively cross-referencing, validating, and linking together information related to investigation sites, materials collected/analysed, and individuals interviewed?



### Question 3:

What are the best practices for management of data collected in investigations, including compilation, curation, and analytics?



### Question 4:

What are the best practices for the collection, handling, curation and storage, and annotation of evidence?



### Question 5:

Which technologies and methodologies (whether established or new) allow point-of-care and non-destructive measurements at an investigation site to help guide evidence collection?



### Question 6:

Which technologies and methodologies (whether established or new) can be used in the provenancing of chemical and/or material samples collected in an investigation?



### Question 7:

Which methods are available (or are being developed) for the sampling and analysis of environmental and biomedical materials and can be used in the detection of toxic industrial chemicals relevant to the Chemical Weapons Convention?



### Question 8:

Which technologies and methodologies (whether established or new) can be used in ensuring chain of custody and verifying authenticity (especially in regard to digital images and video recordings)?



### Question 9:

Which technologies and methodologies (whether established or new) can be used to ensure the integrity of an investigation site?



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Do collections of physical objects, samples, and other information for chemical weapons-related analysis exist and can they be made available to investigators for retrospective review? How might these collections be used to support investigations?

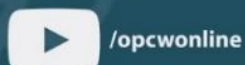


### Question 11:

Are there stakeholders that the Technical Secretariat could usefully engage with to leverage their capabilities on investigative matters?



In addition, the TWG will provide advice on Technical Secretariat proposals for methodologies, procedures, technologies, and equipment for investigative purposes.











**Chemical Forensics: Capabilities across the Field and the Potential Applications in  
Chemical Weapons Convention Implementation**

*Helsinki, Finland. 20 to 22 June 2016*

SAB-24/WP.1, dated 14 July 2016, URL: <http://q-r.to/bap1gy>

Coorganizer: VERIFIN





Summary of the First Meeting of the Scientific Advisory Board's Temporary Working Group (TWG) on Investigative Science and Technology.  
(SAB-27/WP.1, dated 26 February 2018)



Summary of the Second Meeting of the Scientific Advisory Board's Temporary Working Group (TWG) on Investigative Science and Technology.  
(SAB-28/WP.2, dated 21 January 2019)



Summary of the Third Meeting of the Scientific Advisory Board's Temporary Working Group (TWG) on Investigative Science and Technology.  
(SAB-28/WP.3, dated 4 June 2019)



### Science for Diplomats at RC-4 and the Spiez Laboratory Present:

Convergence  
and Solving Chemical Mysteries

a Transdisciplinary Look  
at Scientific Advances  
and Problem Solving

Friday, 23 November 2018

13:00 - 15:00 Europe Room World Forum  
Light Lunch provided



The Temporary Working Group at Science for Diplomats, November 2018.  
"solving chemical mysteries".



Solving the mystery:





For further information on the TWG  
Scan the QR codes!

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Technology (SAB-28/WP.3, dated 4 June 2019)



OPCW

Twenty-Ninth Session  
6 – 10 April 2020

Scientific Advisory Board

SAB-29/WP.1  
25 November 2019  
ENGLISH only

**SUMMARY OF THE FOURTH MEETING OF THE SCIENTIFIC ADVISORY BOARD  
TEMPORARY WORKING GROUP ON INVESTIGATIVE SCIENCE  
AND TECHNOLOGY**

1. **AGENDA ITEM ONE – Opening of the meeting**
  - 1.1 The Scientific Advisory Board's (SAB) Temporary Working Group (TWG) on Investigative Science and Technology held its Fourth Meeting from 18 to 20 September 2019 at OPCW Headquarters in The Hague. The meeting was chaired by Dr Veronica Borrett on behalf of the SAB, with support from Vice-Chairperson Dr Ed van Zalen.
  - 1.2 After welcoming the TWG members, invited guest speakers and observers, Dr Borrett summarised the outcome of the TWG's Third Meeting which had been held from 2 to 4 April 2019,<sup>2</sup> and discussed objectives for the Fourth Meeting and how these fit with the SAB's mandate to explore new and emerging technologies<sup>3</sup> and the TWG's focus on science and technology relevant to investigations mandated under Articles IX and X of the Chemical Weapons Convention (hereinafter, "the Convention").<sup>4</sup> She

<sup>1</sup> These dates are tentative.  
<sup>2</sup> "Summary of the Third Meeting of the Scientific Advisory Board's Temporary Working Group on Investigative Science and Technology" (SAB-28/WP.3, dated 4 June 2019): [www.opcw.org/sites/default/files/documents/2019/06/sab-28-wp03%28-%29.pdf](http://www.opcw.org/sites/default/files/documents/2019/06/sab-28-wp03%28-%29.pdf).  
<sup>3</sup> (a) "Report of the Scientific Advisory Board on Developments in Science and Technology for the Fourth Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention" (RC-4/DG.1, dated 30 April 2018); [www.opcw.org/sites/default/files/documents/CSP-RC-4/en/rc4dg01\\_e.pdf](http://www.opcw.org/sites/default/files/documents/CSP-RC-4/en/rc4dg01_e.pdf).  
(b) "Innovative Technologies for Chemical Security", J. E. Forman, C. M. Timperley, P. Aas, M. Abdollahi, I. P. Alonso, A. Baulig, R. Becker-Arnold, V. Borrett, F. A. Cariño, C. Curry, D. Gonzalez, Z. Kovarik, R. Martinez-Alvarez, R. Mikulak, E. de Souza Nogueira, P. Ramasami, S. K. Raza, A. E. M. Saeed, K. Takeuchi, C. Tang, F. Triñiño, F. M. van Straten, F. Waqar, V. Zaitsev, M. Said Zina, K. Grolmusová, G. Valente, M. Payva, S. Sun, A. Yang, D. van Eerten; *Pure Appl. Chem.*, 2018, 90(10), 1527-1557. DOI: 10.1515/pac-2018-0908. (c) "Report of the Scientific Advisory Board's Working Group on Emerging Technologies" (SAB-26/WP.1, dated 21 July 2017): [www.opcw.org/sites/default/files/documents/SAB-en-sab-26-wp01\\_e.pdf](http://www.opcw.org/sites/default/files/documents/SAB-en-sab-26-wp01_e.pdf).  
<sup>4</sup> For the terms of reference, see Annex I to the Summary of the First Meeting of the Scientific Advisory Board's Temporary Working Group on Investigative Science and Technology: (SAB-27/WP.1, dated 26 February 2018); [www.opcw.org/sites/default/files/documents/SAB-en-sab-27-wp01\\_e.pdf](http://www.opcw.org/sites/default/files/documents/SAB-en-sab-27-wp01_e.pdf). A quick reference guide to the questions contained within the Terms of Reference is available at: [www.opcw.org/sites/default/files/documents/SAB/en/TWG\\_Investigative\\_Science\\_Tech\\_Questions.pdf](http://www.opcw.org/sites/default/files/documents/SAB/en/TWG_Investigative_Science_Tech_Questions.pdf).

CS-2019-2129(E) distributed 25/11/2019



**Science for Diplomats  
and the Spiez Laboratory**

**Convergence  
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**a Transdisciplinary  
at Science  
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**Friday, 23 November 2018  
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Solving the mystery:





Temporary Working Group on Investigative Science  
5<sup>th</sup> meeting, Helsinki, Finland, 21 November 2019



End of mandate Report Forthcoming



# **Scientific Advisory Board of the OPCW**

## **Temporary Working Group on Investigative Science and Technology**

**Presented by Dr Veronica Borrett  
Chairperson, TWG on Investigative Science**



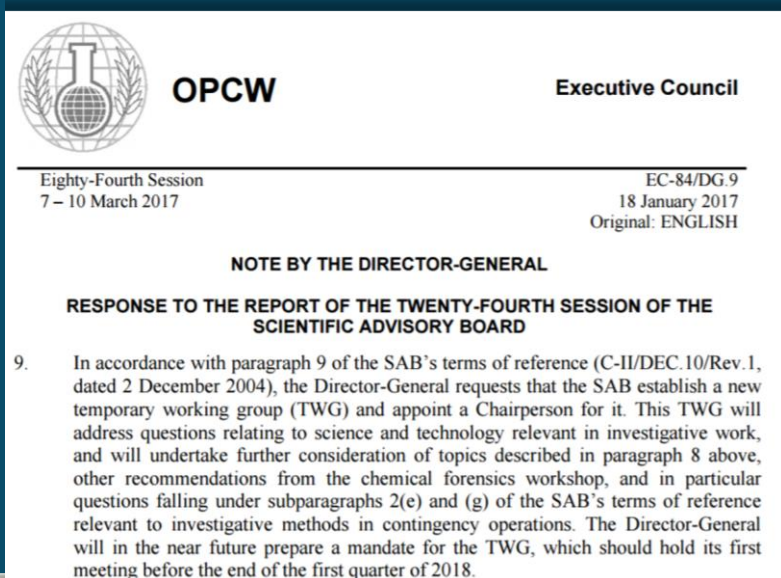
## SAB REPORTS REVIEWED PRIOR TO FIRST TWG MEETING INCLUDE:

OPCW/VERIFIN Workshop "Chemical Forensics: Capabilities across the Field and the Potential Applications in CWC Implementation" Helsinki 2016

SAB Session Reports, SAB-22

TWG on Verification Final Report

OPCW/IUPAC/ABC/AAS "International Workshop on Innovative Technologies for Chemical Security" Brazil 2017







**OPCW**

Eighty-Fourth Session  
7 – 10 March 2017

## NOTE BY THE DIRECTOR-GENERAL

### RESPONSE TO THE REPORT OF THE SCIENTIFIC ADVISORY BOARD

9. In accordance with paragraph 9 of the S dated 2 December 2004), the Director-General, the Director of the Scientific Advisory Board (SAB) and the temporary working group (TWG) and will undertake further consideration and will undertake further consideration and will undertake further consideration other recommendations from the chemical questions falling under subparagraphs 2 relevant to investigative methods in chemical will in the near future prepare a mandate meeting before the end of the first quarter.



**OPCW**

**Review Conference**

Fourth Session  
21 – 30 November 2018

RC-4/DG.1  
30 April 2018  
Original: ENGLISH

## REPORT OF THE SCIENTIFIC ADVISORY BOARD ON DEVELOPMENTS IN SCIENCE AND TECHNOLOGY FOR THE FOURTH SPECIAL SESSION OF THE CONFERENCE OF THE STATES PARTIES TO REVIEW THE OPERATION OF THE CHEMICAL WEAPONS CONVENTION

### Introduction

1. The Scientific Advisory Board (SAB) was established by the Director-General in accordance with subparagraph 21(h) and paragraph 45 of Article VIII of the Chemical Weapons Convention (hereinafter “the Convention”), so that he could render to the Conference of the States Parties (hereinafter “the Conference”) and the Executive Council (hereinafter “the Council”) specialised advice in areas of science and technology relevant to the Convention. In keeping with this mandate, and as its contribution to the Fourth Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention (hereinafter “the Fourth Review Conference”), to be held from 21 to 30 November 2018, the SAB has prepared this report, which analyses relevant developments in science and technology over the past five years and presents recommendations and observations that the SAB considers to be important for the review of the operation of the Convention and its future implementation.
2. This report contains an executive summary and recommendations addressing issues that may impact the implementation of the Convention and the work of the Technical Secretariat (hereinafter “the Secretariat”). The analysis of developments in science and technology that informed the recommendations, as well as additional, more detailed recommendations, are provided in Annex 1.
3. This is the fourth report for a Review Conference by the SAB on developments in science and technology relevant to the Convention. The three earlier reports were presented to the First Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention<sup>1</sup> (hereinafter “the First Review Conference”), the Second Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention<sup>2</sup> (hereinafter “the Second Review Conference”), and the Third Special Session of the Conference

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## BACKGROUND

- ▶ The OPCW/VERIFIN convened a Workshop on "Chemical Forensics: Capabilities across the Field and the Potential Applications in CWC Implementation" in Helsinki 2016.
- ▶ In its report from the workshop, the SAB recommended (SAB-24/WP.1) that additional workshops or a temporary working group (TWG) could be considered to strengthen the understanding of technologies, procedures and capabilities that forensics can bring to investigations.
- ▶ The SAB also highlighted the importance of engagement with forensic experts, forensic practitioners and OPCW inspectors and laboratories, to explore methods and capabilities relevant to the verification of the Chemical Weapons Convention.



# REPORTING

TWG established by the SAB at the direction of the OPCW Director General

TWG report and recommendations reviewed and approved by SAB (Scientific Advisory Board)

SAB provides TWG report to the Director General for consideration



# REPORTING

TWG established by the SAB of the



SAB provides TWG report to the Director General for consideration



# TERMS OF REFERENCE

**OBJECTIVES: TO REVIEW SCIENCE AND TECHNOLOGY RELEVANT TO INVESTIGATIVE WORK, ESPECIALLY FOR THE VALIDATION AND PROVENANCING (DETERMINING THE CHRONOLOGY OF OWNERSHIP, CUSTODY AND/OR LOCATION) OF EVIDENCE, AND THE INTEGRATION OF MULTIPLE AND DIVERSE INPUTS TO RECONSTRUCT A PAST EVENT.**

TWG will consider key questions and in addition, “... will provide advice on Technical Secretariat proposals for methodologies, procedures, technologies, and equipment for investigative purposes”.

Gaps and new technologies





# ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Working Together For a World Free of Chemical Weapons

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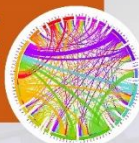
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In addition, the TWG will provide advice on Technical Secretariat proposals for methodologies, procedures, technologies, and equipment for investigative purposes.





## TWG ON INVESTIGATIVE SCIENCE AND TECHNOLOGY

# MEMBERS

- ▶ Veronica Borrett (Australia); TWG Chair \*
  - ▶ Ed van Zalen (Netherlands Forensic Institute (NFI); TWG Vice Chair
  - ▶ Cheng Tang (China); SAB Chair \*
  - ▶ Christophe Curty (Switzerland); SAB Vice-chair \*
  - ▶ Robert Mikulak (USA) \*
  - ▶ Syed Raza (India) \*
  - ▶ Farhat Waqar (Pakistan) \*
  - ▶ Daan Noort (TNO, The Netherlands)\*
  - ▶ Crister Åstot (FOI, Sweden)
  - ▶ Brigitte Dorner (RKI, Germany)
  - ▶ Carlos Fraga (Pacific Northwest National Laboratory, USA)
  - ▶ Paula Vanninen (VERIFN, Finland)
  - ▶ Francois van Straten (South Africa)
  - ▶ Christopher Timperley (United Kingdom); Former SAB Chair
  - ▶ Augustin Baulig (France)
  - ▶ David Gonzalez (Uruguay)
- 
- ▶ Valentin Rubaylo (Russian Federation)

**\* SAB Members**



## TWG ON INVESTIGATIVE SCIENCE AND TECHNOLOGY MEMBERS

VALE

### Valentin Rubaylo (Russian Federation)

Valentin, a colleague, a friend, and a scientist, will be dearly missed.

The Temporary Working Group on Investigative Science and Technology recognises the expertise and contributions of Mr Valentin Rubaylo who passed away in June 2019.

Mr Rubaylo, a member of the TWG, and also the SAB since 2014, had also served on the SAB's TWG on Verification. He was one of the first Chemical Demilitarisation Officers to be appointed to the Secretariat at the time of the entry-into-force of the Convention.

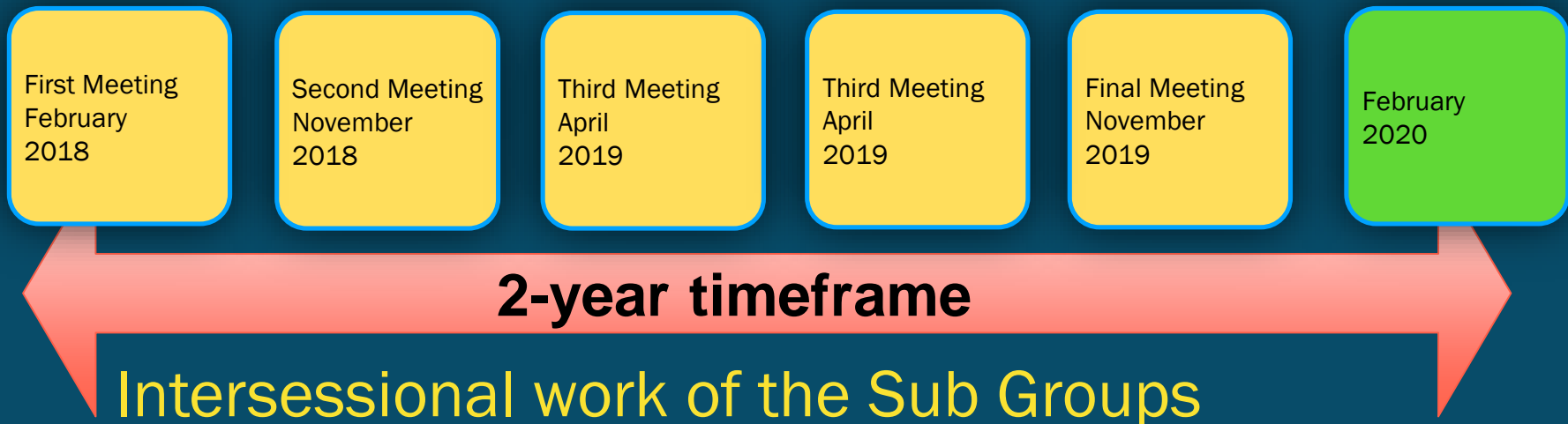


## TIMELINE

- ▶ First meeting was held 12 to 14 February 2018
- ▶ Second meeting was held 14 to 16 November 2018
- ▶ Third meeting 2 to 4 April 2019
- ▶ Forth meeting 18 to 20 September 2019
- ▶ Final meeting 18 to 20 November 2019

## REPORTING

- ▶ Report to the SAB Sessions 27 and 28
- ▶ Interim Recommendations endorsed by SAB at it 28<sup>th</sup> Session June 2019
- ▶ Final Report Complete and to be considered by the SAB





# SETTING THE SCENE



Image: OPCW

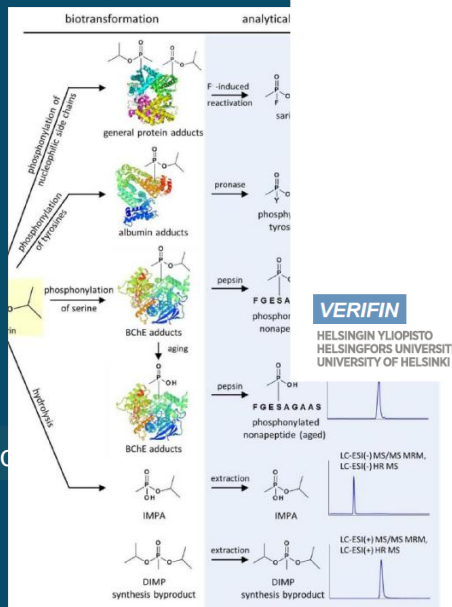
AS 5388 Forensic Analysis			
AS 5288.1 Recognition, recording, recovery, transport and storage of material	AS 5288.2 Analysis and examination of material Analysis	AS 5288.3 Interpretation	AS 5288.4 Reporting
5 Systematic Approach to	5 Acceptance of Physical	6 Transforming Data into	5 General Provisions



RECOMMENDED OPERATING PROCEDURES  
FOR ANALYSIS IN THE VERIFICATION OF  
CHEMICAL DISARMAMENT  
2017 Edition

Part I

RECOMMENDED OPERATING PROCEDURES  
FOR ANALYSIS IN THE VERIFICATION OF



2017

CHEMICAL FORENSICS INTERNATIONAL  
TECHNICAL WORKING GROUP  
INAUGURAL WORKSHOP REPORT

APRIL 5, 2017  
SAN FRANCISCO,  
CALIFORNIA, USA

Profiling of CW to determine pro

CHEMICAL  
FORENSICS  
INTERNATIONAL TECHNICAL WORKING GROUP EST. 2017



# SETTING THE SCENE



SAB-27/WP.1

Summary of the First Meeting of the Scientific  
Advisory Board's Temporary Working Group  
on Investigative Science and Technology

Image: OPCW

## AS 5388 Forensic Analysis

AS 5288.1 Recognition,  
recording, recovery, transport  
and storage of material

AS 5288.2 Analysis and  
examination of material  
Analysis

AS 5288.3 Interpretation

AS 5288.4 Reporting

26 February 2018



RECOMMENDED OPERATING PROCEDURES  
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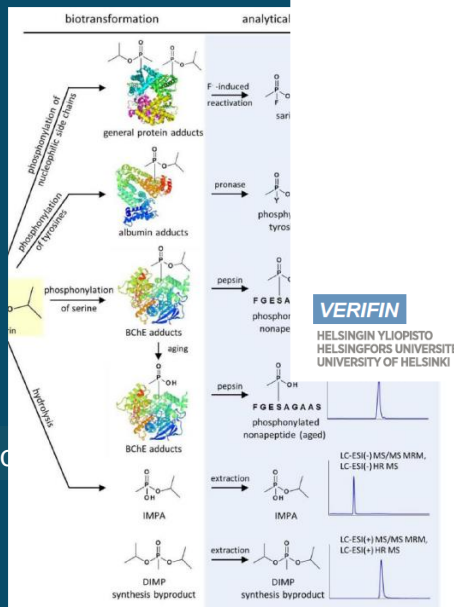
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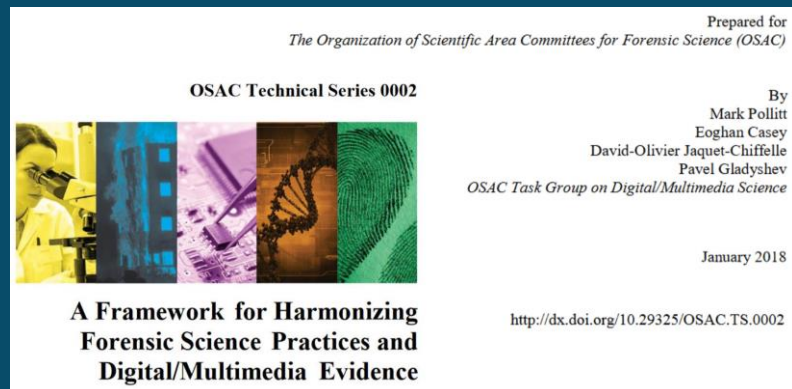
CHEMICAL  
FORENSICS  
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VERIFIN  
HELSINGIN YLIOPISTO  
HELSINGFORS UNIVERSITET  
UNIVERSITY OF HELSINKI



# TECHNOLOGY



Authentication and validation of data

Chlorine markers and biomarkers



UAV/UGV and robotics for sampling



Imagery: Value and need for expert interpretation



## TWG ON INVESTIGATIVE SCIENCE AND TECHNOLOGY MEETING 2

# TECHNOLOGY

Prepared for  
*The Organization of Scientific Area Committees for Forensic Science (OSAC)*

OSAC Technical Series 0002



**A Framework for Harmonizing  
Forensic Science Practices and  
Digital/Multimedia Evidence**

By  
Mark Pollitt  
Eoghan Casey  
David-Olivier Jaquet-Chiffelle  
Pavel Gladyshev  
*OSAC Task Group on Digital/Multimedia Science*

January 2018

<http://dx.doi.org/10.29325/OSAC.TS.0002>

Authentication and validation of data

Chlorine markers and biomarkers

SAB-28/WP.2

Summary of the Second Meeting of the Scientific  
Advisory Board Temporary Working Group on  
Investigative Science and Technology

21  
January  
2019



UAV/UGV and robotics for sampling



Imagery: Value and need for expert interpretation





# TWG ON INVESTIGATIVE SCIENCE AND TECHNOLOGY

DAY 2 Hosted by NFI

Forensic processes and techniques

Importance of advice, oversight and training

Forensic biometrics  
and data validation

Forensic BIGdata analysis

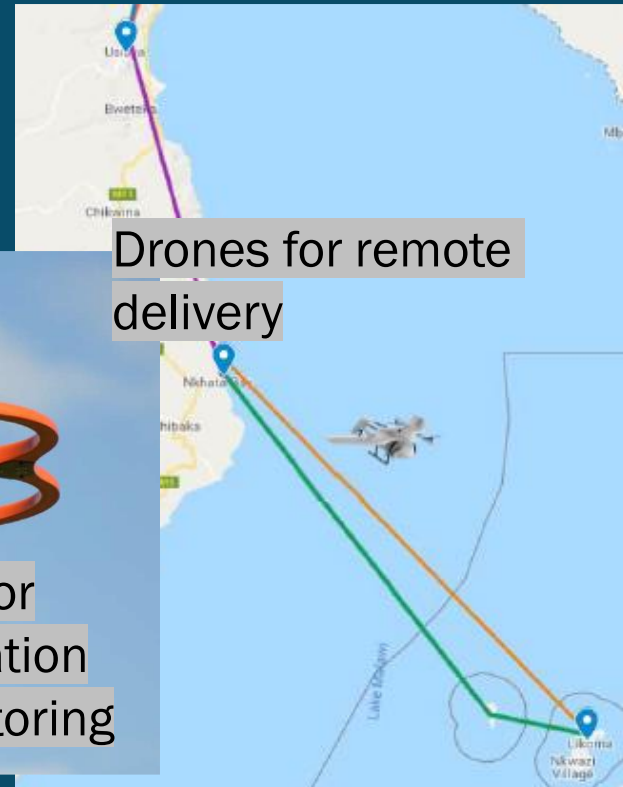
Database for evidence collection,  
retention and organisation

Remote verification OPCW  
HQ

Using mobile phone apps  
to record events

Drones for remote  
delivery

UAV for  
Radiation  
monitoring



## RECOMMENDATIONS ENDORSED AT SAB 28

- ▶ Pursuant to the deliberations of the SAB at its Twenty-Eighth Session, the Board recommends the following to the Director-General through its report:
- ▶ 1. A forensic advisor with broad experience in forensic science and international law should be considered to provide advice to the Director-General and the OPCW. An independent external expert could be considered.
- ▶ 2. The Secretariat should ensure that forensic issues are included in standard operating procedures (SOPs) or working instructions including those related to on-site sample collection, handling, curation and storage, and annotation, in accordance with forensic best practices.
- ▶ 3. Relevant OPCW staff should receive training on forensic processes, procedures, and techniques relevant to their role.
- ▶ 4. Scenarios developed for mission planning and training should be adapted for the purpose of evaluating sampling and detection systems to meet mission conditions.



## TWG4 18 to 20 September 2019

<https://www.opcw.org/sites/default/files/documents/2019/11/sab-29-wp01%28e%29.pdf>

Focus on:

information management

digital approaches for tracking chain-of-custody and determination of provenance, including distributed ledger technologies and track/trace systems, and

some further laboratory and analytical approaches to analysis of CWC related chemicals

Important to the work of the TWG has been the engagement with the Secretariat in all of the TWG meetings. Presentations and input to discussions from senior management and staff, including inspectors experienced in non-routine missions and the OPCW Laboratory.

Presentations and input from external experts experienced in forensic operations and research.

This supported an iterative process where the Secretariat provided the critical operational requirements to the TWG, while having the opportunity to engage with the external experts. Perhaps a model for any future TWG.



# FINAL REPORT

- ▶ Over 60 pages, 36 Recommendations – including 4 already considered at SAB28
- ▶ These cover the general areas of:
  - ▶ Access to forensic advice to support the preparation for, conduct of and review of outcomes of non-routine missions
  - ▶ Access to a broader base of laboratory and technical capabilities, such as forensic labs and specialist equipment
  - ▶ Enhanced capabilities for sampling, detection and analysis
  - ▶ Remote and automated capabilities for assessing a site and collecting information/samples
  - ▶ Approaches for ensuring chain of custody, including new technologies for digital tracking
  - ▶ Approaches to information management
  - ▶ Strengthening capabilities for chemical profiling/provenancing
  - ▶ Harness expertise of current and former OPCW personnel who have participated in non-routine missions



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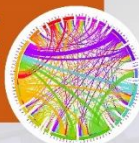
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In addition, the TWG will provide advice on Technical Secretariat proposals for methodologies, procedures, technologies, and equipment for investigative purposes.



@opcw  
@opcw\_st



/opcwonline



/opcwonline



/company/opcw



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## **Subgroup A. Forensic Methods and Capabilities**

- ▶ 1. Which methods and capabilities used in the forensic sciences could usefully be developed and/or adopted for Chemical Weapons Convention-based investigations?
- ▶ 11. Are there stakeholders that the Technical Secretariat could usefully engage with to leverage their capabilities on investigative matters?

## **Sub-group A, forensic methods, and capabilities**

The sub-group identified the need for an impartial forensic advisor as a critical function for any investigation team. This advisor would act as an intermediate between the investigating team and the forensic laboratory. The advisor must have a broad background in forensic analysis and familiarity with chemical weapons issues, knowledge of applicable (inter)national laws, and knowledge of networks of forensic laboratories as well as the DLs. Operationally, the forensic advisor provides advice for the selection of exhibits to be examined in relation to the incident occurred and investigative questions, guides the phrasing of forensic questions and explains the outcome of the forensic analysis. Any individual in this role must also possess strong communication skills.

The sub-group also discussed the selection of laboratories for forensic analysis beyond what the DLs can provide. Considerations should include ISO 17025 accreditation, whether the labs participate in relevant proficiency testing (which should be broader than just laboratory tests, including exhibit sampling and interpretation/conclusion), capability to handle (possible) contaminated evidence, capabilities matched to investigative needs, and ensuring confidentiality requirements.

There is a need for identifying laboratories with geographic diversity, and establishing memorandums of understanding or other suitable relationships. The roles of government ministries, delegations and National Authorities in the working relationships with any potential partner laboratory must also be considered.



## **Subgroup B. Data Collection and Management**

- ▶ 2. What are the best practices and analysis tools used in the forensic sciences for effectively cross-referencing, validating, and linking together information related to investigation sites, materials collected/analysed and individuals interviewed?
- ▶ 3. What are the best practices for management of data collected in investigations, including compilation, curation, and analytics?

## **Sub-group B, data collection, and management**

In regard to best practices and analysis tools used in the forensic sciences for effectively cross-referencing, validating, and linking together information related to investigation sites, materials collected/analysed and individuals interviewed, the sub-group reviewed literature on management of digital and physical evidence.

The sub-group noted that the Generic Integrated Forensic Toolbox for CBRN incidents (GIFT Forensics) has been completed and the tools which it had developed may be of interest to evaluate.

In regard to the best practices for management of data collected in investigations including compilation, curation, and analytics, the sub-group noted the work of other agencies on forensic science SOPs.



## **Subgroup C. Sampling, Detection and Analysis**

- ▶ 5. Which technologies and methodologies (whether established or new) allow point-of-care and non-destructive measurements at an investigation site to help guide evidence collection?
- ▶ 7. Which methods are available (or are being developed) for the sampling and analysis of environmental and biomedical materials and can be used in the detection of toxic industrial chemicals relevant to the Chemical Weapons Convention?

## Sub-group C, sampling, detection, and analysis

Sub-group C has compiled information on fieldable point-of-care tests for assessing exposure to classical agents (nerve agents and sulfur mustard), point-of-care devices and technologies for detection of ricin, commercially available technologies for on-site chemical detection/identification in the environment, and point-of-care devices and technologies for detecting toxic industrial chemicals and toxins (ricin and saxitoxin).

New developments for identifying potential biomarkers in biomedical samples.



## **Subgroup D. Integrity of Scene and Evidence Collection**

- ▶ 4. What are the best practices for the collection, handling, curation and storage, and annotation of evidence?
- ▶ 8. Which technologies and methodologies (whether established or new) can be used in ensuring chain of custody and verifying authenticity (especially in regard to digital images and video recordings)?
- ▶ 9. Which technologies and methodologies (whether established or new) can be used to ensure the integrity of an investigation site?

## **Sub-group D data collection and integrity of scene, evidence and evidence collection**

In regard to best practices for the collection, handling, curation and storage and annotation of evidence, the sub-group has been reviewing operating protocols and procedures to identify areas that might benefit from the exploration of new tools and methods..

In regard to exploring how others approach the reconstruction of past events and physical locations, the sub-group reviewed operating procedures used by others for the evaluation of inspected areas, the application of integrated approaches to forensic investigations of threat agents.

Site mapping and documentation, which could review UAVs, imaging analysis, 3D and 2D scanning, new sensors, and RFID tagging was assessed.

Review the procedures and equipment for sample packaging and transport.



## **Subgroup E. Provenance**

- ▶ 6. Which technologies and methodologies (whether established or new) can be used in provenancing of chemical and/or material samples collected in an investigation?
- ▶ 10. Do collections of physical objects, samples and other information for chemical weapons-related analysis exist and can they be made available to investigators for retrospective review? How might these collections be used to support investigations?

## Sub-group E, provenance

In regard to coordination with, and encouragement of laboratories to be more actively engaged with, the CFITWG, the TWG, and OPCW Secretariat have provided contacts and support to the CFITWG leadership for the recruitment of experts from DLs and other international organisations.

In regard to identifying others whose work relies heavily on provenancing, the sub-group engaged with experts from areas such as food forensics, environmental forensics, illicit drug forensics and toxin analysis. There is a need to learn best practices on the standardisation, storage, and maintenance of instrumental data (raw and/or process) for chemical forensics application.

The sub-group highlighted the value of keeping samples and raw data in a format that can be used in the future for chemical forensics applications.

## **Subgroup F.**

Sub-group F will address additional considerations, with focus on paragraph of the TWG TOR, providing advice on Technical Secretariat proposals for methodologies, procedures, technologies and equipment for investigative purposes.



## Sub-group F, additional considerations

Traditional approaches are not suitable for situations in which inspectors are not able to travel to sites to be inspected or in which witnesses are unable to meet with inspectors because of travel difficulties.

Inspector time on-site may be very limited and return visits not possible. Thus, there is a need to identify and discuss possible ways to enable inspectors to document a site rapidly and to collect as much relevant information on-site as possible.

A number of non-traditional means for collecting relevant information have been identified and assessed. Possibilities include: use of unmanned aerial vehicles to conduct tasks at the site of interest, perhaps in combination with actions by local personnel; smartphone apps to assist in collection and authentication of information; and use of open-source imagery or other information, including means to confirm its authenticity.

Technical investigative assistance to States Parties may involve OPCW personnel in a process leading to domestic criminal prosecution. This could raise a number of potential complex legal issues that may require consideration.

# **Investigative Science and Technology**

## **Report of the Scientific Advisory Board's Temporary Working Group**

# EC-92/DG.12 DG RESPONSE TO THE SAB28 REPORT

- ▶ The Director-General thanks the SAB for the recommendations submitted through SAB-28/1. The scientific methodologies employed by the Secretariat must be rigorous and robust, and the Director-General is pleased to see these principles underpinning the SAB-28 recommendations. The Director-General submits the following perspectives on the SAB's recommendations:
  - 
  - ▶ (a) Given the high standards to which information collected in non-routine operations is held when used for decision making, the recommendation of sub-paragraph 1.3(a) of SAB-28/1, i.e., to provide the Director-General access to forensic advice through an expert advisor, is of particular relevance. The Secretariat is exploring the modalities of how such an advisory role might be operationalised.
  - 
  - ▶ (b) In response to sub-paragraphs 1.3(b) and 1.3(c) of SAB/28-1, which contain recommendations looking to ensure that Secretariat staff are suitably trained and follow appropriate operating procedures for any mission with an investigative dimension, the Director-General notes that the Secretariat's training programmes and operating procedure review process have taken these approaches into account and will continue to do so.
  - 
  - ▶ (c) In response to sub-paragraph 1.3(d) of SAB-28/1, the Director-General recognises that an ongoing evaluation process for new equipment benefits immediate capability needs and helps to ensure that the Secretariat keeps pace with technological changes. The Director-General has encouraged the Secretariat to identify capability needs and the situations where such capabilities are beneficial. Training scenarios that match these needs with suitable enabling technologies are ideally suited for equipment evaluation.



## GENERAL CONSIDERATIONS

- ▶ Operational context - challenges and requirements
- ▶ Laboratory capabilities
- ▶ Current best-practice and SOPs
- ▶ What new capabilities and connections are required?
- ▶ Connections with forensic community and other experts
- ▶ Forward thinking and emerging technologies from broader scientific community
- ▶ Approaches to combine multiple information streams

## TECHNOLOGY SOLUTIONS

- ▶ Ability to apply a Systems Approach to equipment, data and processes (implications at acquisition phase)
- ▶ The ability to access and apply new technology solutions for evaluating and documenting a scene or equipment, and detection and sampling.
  - ▶ help highlight sampling hotspots (the best place to take a sample)
    - ▶ can reduce the number of samples and increase their utility, reduce logistic burden and workload for OPCW lab and DL
    - ▶ increase effectiveness of time spent at the scene
  - ▶ support risk assessment for inspectors
  - ▶ support planning to reduce the time required at a scene - e.g. to reduce hazards that may be associated with working in personal protective equipment
  - ▶ to provide a record for retrospective evaluation - e.g. using 3D scanning
- ▶ Robust forensic methods to ensure the integrity of information and sampled materials
  - ▶ Best practice for chain of custody, scene documentation, detection and analysis
- ▶ Site assessment, documentation, sampling and analysis, and Chain of Custody may benefit from the application of technology solutions, such as:
  - ▶ UGV/UAVs,
  - ▶ imaging (particularly satellite imaging),
  - ▶ new approaches to information gathering
  - ▶ 3D and 2D scanning, and
  - ▶ inclusion of electronic tags (e.g RFIDs) for monitoring, tracking and Chain of Custody.

Science For Diplomats at CSP-24 Presents:

# The Return of the Chemical Mystery



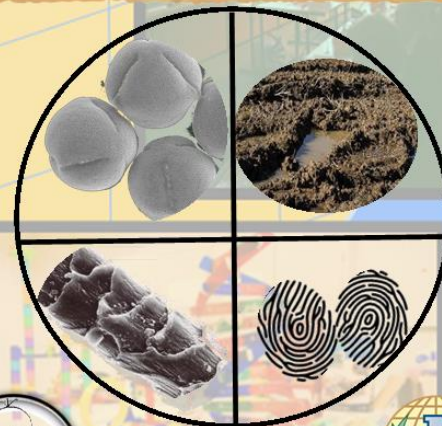
The inspectorate joins us to take you on a chemistry mission guided with advice from the Temporary Working Group on Investigative Science and Technology

**Wednesday 27 November 2019**

**13:15-14:45**

**Europe Room, World Forum**

**Light Lunch available at 13:00**



OPCW





**Well, it wouldn't be "Science for Diplomats" without some fun and games...  
Your turn to investigate..**



The last time...

# Science for Diplomats at RC-4 and the Spiez Laboratory Present:

*Convergence  
and Solving Chemical Mysteries*

**a Transdisciplinary Look  
at Scientific Advances  
and Problem Solving**

**Friday, 23 November 2018**

**13:00 -15:00 Europe Room World Forum**

**Light Lunch provided**





# at RC-4 Present:



## Disciplinary Look at Advances in Problem Solving

**Friday, 23 November 2018**  
**13:00 -15:00 Europe Room World Forum**  
**Light Lunch provided**





**at RC-4  
Present:**



Light Lunch provided

OPCW





**at RC-4  
Present:**

**Your Game is  
WAY  
TOO HARD**

Light Lunch provided

OPCW





**This time we are letting the Inspectors (not the Science Board) run the mission!**



**Will it be easier?**



**Diplomats, inspectors and  
scientists!**



**Dr Zrinka Kovarik**  
2020 Vice-Chair  
Scientific Advisory Board

MEXICO

GAMBIA



# The Mission: “Fact-Finding Cluedo”

- Five events have taken place that appear to be involve toxic chemical exposure

***You only need to respond to one of them!***

***(which will be assigned...)***

- Perform on-site analysis to collect clues
- Identify the chemical and its provenance
  - Is this an incident involving a chemical weapon?



Follow the ROP's and SOP's!





# Follow the ROP's and COP's!

## Return of the Chemical Mystery

#ScienceForDiplomats

Five events involving chemicals have recently taken place. Your task is to join an inspection team looking into one of the five cases, collect clues, and identify the chemical and its provenance. Is this an incident involving a chemical weapon? Think of this as "Science for Diplomats - Fact-Finding Cluedo"!

### Let's begin...

In front of you is a game board with six locations that have coloured tracking devices. You should also see a set of envelopes, each marked with a specific colour – these are your clues. **Please DO NOT OPEN until instructed!**

You also have a light stick, turn it on!



If your light stick indicates **the colour blue**, you start at the "Laboratory".

If your light stick indicates **the colour purple**, you start at the "Equipment Store".

If your light stick indicates **the colour yellow**, you start in the "Office of the Science Policy Adviser".

If your light stick indicates **the colour green**, you start in the "Ooms Room".

If your light stick indicates **the colour red**, you start in the "Ieper Room".

After finding your starting point, follow the specific on-site analysis instructions for that location.

### What comes next?

The Temporary Working Group on Investigative Science and Technology organised itself into six sub-groups and the deliberations of each will be presented by the Group's Chair, Dr Veronica Borrett. As Dr Borrett's briefing moves from one sub-group to the next, **you can move in either a clockwise or counterclockwise direction to an adjacent room, that is NOT the situation centre (you must also track your movement with Blockchain).** In each room you will be asked to perform an on-site analysis to retrieve your next clue. **Follow the "On-site analysis" instruction sheet specific to the room you have entered.**

## The Rules

- Tracking and chain-of-custody.** With each room you enter, you must create a "Blockchain". Start with the tracking device in your starting location, add a new tracking device each time you enter a different room (attach to the device from the previous room). To do this, add a drop of water to the device and stick the next device onto it.
- Rooms have limited access.** Each room has a specific set of instructions to follow and depending on the outcome of the on-site analysis for that room, you may receive another clue. **If you return to a room you have previously been to, you cannot repeat the on-site analysis.** If you enter a room twice, raise your light stick to receive a repeat (and coloured white) tracking device.



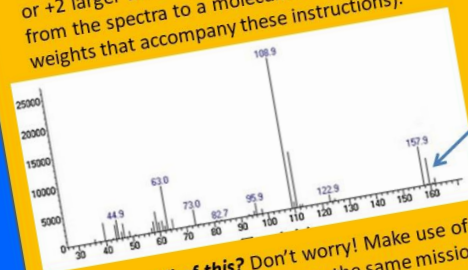
- The Situation Centre.** The "grey room" is the Situation Centre. You can only enter this room after you have completed the on-site tests at the other five locations (enter directly from anywhere on the board). The on-site analysis in this location will present you with a choice of one of two clues which were provided to the inspection team by external sources. **Do you trust the source?** You can choose not to take the clue (which means there is no need to perform the test) or you can choose one of the two clues based on the results of the on-site analysis.

- Once you have visited all six rooms, you must move the "BlockChain" to the OPCW logo space on the game board. Be the first to answer the questions in your mandate (see page 1 of these instructions) and you might win a prize!**

## Off-site Analysis

Several clues provide mass spectral data. Here is a crash course in interpretation:

- The mass spectrum you will see is a plot of intensity (or abundance) vs. mass-to-charge ( $m/z$ ) ratio for the fragments of a molecule of a specific chemical substance. The pattern is like a "fingerprint" for the specific molecule.
- The highest  $m/z$  values on in the spectra correspond to the molecular weight of the actual molecule (with some protons attached to give it a positive charge a readout potentially +1 or +2 larger than the actual molecular weight). **This is your clue.** Match the molecular mass from the spectra to a molecule listed in the table of scheduled and unscheduled molecular weights that accompany these instructions.



Molecular weight (+1 or +2...) can be found here

**Confused by all of this?** Don't worry! Make use of books, handouts, mobile devices and your neighbours (are they on the same mission?) to solve the mystery!





Mystery Return of the Chemical



Science for Diplomats



# Return of

**Team #1**



**Team #4**



**Your mission is determined  
by the light stick**

**Team #2**



**Team #3**



**Team #5**



## Ooms Room



Team #4



### On-site Chemical Analysis Instruction Sheet

#### Disclosure Solution



1. Add two drops of the disclosure solution "DS" to the "S?3" sample vial.
2. Secure the cap on to the "S?3" vial, mix the contents carefully by inversion (at least 10 times!).
3. Wait 1 minute for the colour in "S?3" to develop.

*Open the clue that corresponds to the colour produced by the test  
If there is no clue of that colour d*

Team #3



#5

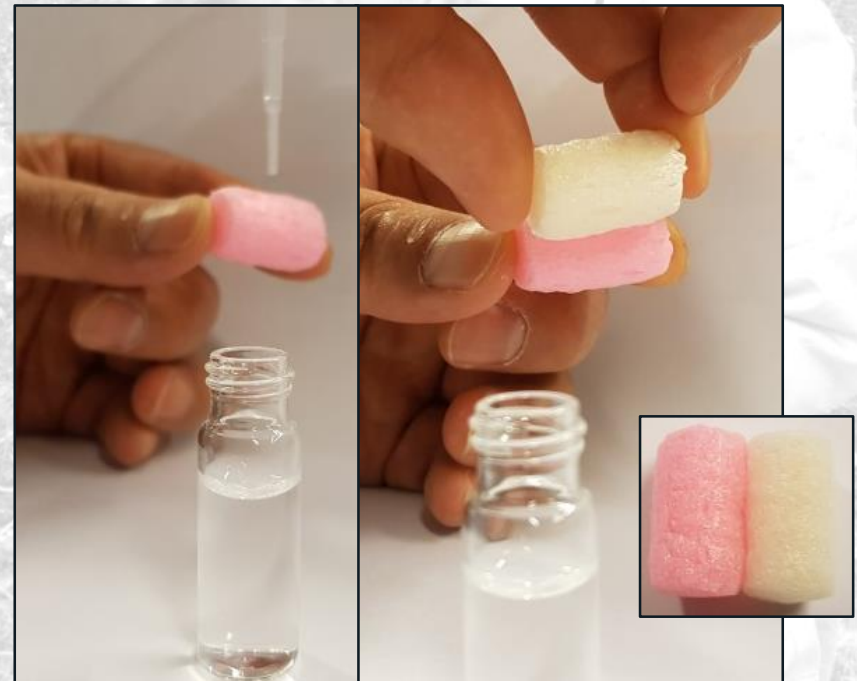


**Follow the instructions for  
the location**



# What Comes Next?

- **Move to a new location every time Dr Borrett introduces the work of a “TWG Subgroup” (A-F)**
  - Move clockwise or counterclockwise to an adjacent location
  - **Limited access:** if you enter the same location twice you cannot perform the on-site test again (e.g. no clue)
- **Document your movements with a “Blockchain”**
  - *Ask the team leader for a white foam piece if you reenter a location*



# Some Helpful Information for Deciphering Clues

## Science for Diplomats Table of Molecular Weight

Name	Molecular Mass	Name	Molecular Mass
1,1,3,3,3-Pentafluoro-2-(trifluoromethyl)-1-propene (PFIB)	200	Morphine	285
1,2-Bis(2-chloroethylthio)ethane (Sesquimustard)	219	N,N'-Bis(tert-butyl)ethylenediimine	168
1,3-Bis(2-chloroethylthio)-n-propane	233	N-V anillyl-7-methyloctanamide (nordihydrocapsaicin)	293
1,4-Bis(2-chloroethylthio)-n-butane	247	N-Vanillyl-9-methyldec-7-(E)-enamide (homocapsaicin)	319
1,5-Bis(2-chloroethylthio)-n-pentane	261	N-Vanillyl-9-methyldecanamide (homodihydrocapsaicin)	321
2,2-Diphenyl-2-hydroxyacetic acid	228	N-Vanillylnonamide (pseudocapsaicin, PAVA)	293
2-Chloroacetophenone (CN)	154	O,O-Diethyl S-[2-(diethylamino)ethyl] phosphorothiolate (Amiton)	269
2-Chlorobenzylidenemalonitrile (CS)	188	O-Ethyl O-2-diisopropylaminoethyl methylphosphonite (QL)	235
2-Chloroethylchloromethylsulfide	145	O-Isopropyl methylphosphonochloridate (Chlorosarin)	156
2-Chlorovinylchloroarsine (Lewisite 1)	207	Oleoresin capsicum (OC)	2633
3'-Chloroacetophenone	154	O-Mustard: Bis(2-chloroethylthioethyl)ether	263
3-Quinuclidinyl benzilate (BZ)	337	O-Pinacolyl methylphosphonochloridate (Chlorosoman)	198
8-Methyl-N-vanillylnonamide (dihydrocapsaicin)	307	Phosgene: Carbonyl dichloride	113
8-Methyl-N-vanillyl-trans-6-nonenamide (capsaicin)	305	Phosphorus oxychloride	153
Arsenic trichloride	181	Phosphorus pentachloride	208
Bis(2-chloroethyl)ethylamine (HN1)	170	Phosphorus trichloride	137
Bis(2-chloroethyl)methylamine (HN2)	156	Pinacolyl alcohol: 3,3-Dimethylbutan-2-ol	102
Bis(2-chloroethylthio)methane	205	Quinuclidin-3-ol	127
Bis(2-chloroethylthiomethyl)ether	235	Ricin	~ 64–65 kDa
Bis(2-chlorovinyl)chloroarsine (Lewisite 2)	233	Sarin (GB)	140
Bis(2-hydroxyethyl)sulfide (Thiodiglycol)	122	Saxitoxin	299
Botulinum toxin	149 kDa	Soman (GD)	182
Chloropicrin: Trichloronitromethane	164	Sulfur dichloride	103
Cyanogen chloride	61	Sulfur monochloride	135
Cyclosarin (GF)	180	Sulfur Mustard (HD)	159
Dibenzo[b,f][1,4]oxazepine (CR)	195	Tabun (GA)	162
Diethyl phosphite	138	Thionyl chloride	119
Dimethyl methylphosphonate	124	Triethanolamine	149
Dimethyl phosphite	110	Triethyl phosphite	166
Ethyl diethanolamine	133	Trimethyl phosphite	124
Hydrogen cyanide	27	Tris(2-chloroethyl)amine (HN3)	204
Methyl diethanolamine	119	Tris(2-chlorovinyl)arsine (Lewisite 3)	259
Methylphosphonyl dichloride	132	Venomous Agent X (VX)	267
Methylphosphonyldifluoride (DF)	100	α-Chlorobenzylidenemalononitrile	188







## The Tests

## leper Room



### On-site Chemical Analysis Instruction Sheet



#### Fluorescent Indicator



1. Add ten drops of the fluorescent indicator solution labelled **FS** to the **"S?4"** sample vial.
2. Secure the cap on to the **"S?4"** vial, mix the contents carefully by inversion (at least 10 times!).
3. Wait 1 minute for the colour in **"S?4"** to develop.

***Open the clue that corresponds to the colour produced by the test  
If there is no clue of that colour do not open any clue***



# Laboratory



## On-site Chemical Analysis Instruction Sheet



### Luminescent Indicator



1. Add ten drops of the luminescent indicator solution **L** to the "**S35**" sample vial.
2. Secure the cap on to the "**S35**" vial, mix the contents carefully by inversion (at least 10 times!).
3. Wait 1 minute for the colour in "**S35**" to develop.

***Open the clue that corresponds to the colour produced by the test  
If there is no clue of that colour do not open any clue***

## Ooms Room



### On-site Chemical Analysis Instruction Sheet

#### Disclosure Solution



1. Add two drops of the disclosure solution "DS" to the "S?3" sample vial.
2. Secure the cap on to the "S?3" vial, mix the contents carefully by inversion (at least 10 times!).
3. Wait 1 minute for the colour in "S?3" to develop.

***Open the clue that corresponds to the colour produced by the test  
If there is no clue of that colour do not open any clue***





## Equipment Store



## On-site Chemical Analysis Instruction Sheet

### Derivatization Test



1. Using a pipette, add 5 drops of solution #1 to the "S?1" sample vial.
2. Secure the cap on to the "S?1" vial, mix the contents carefully by inversion (at least 10 times!).
3. Shake the vial containing solution #2 vigorously for 30 seconds.
4. Using a clean pipette, add 5 drops of solution #2 to the "S?1" vial and shake vigorously for 1 minute.
5. Wait 1 minute for a colour to develop in vial "S?1".

***Open the clue that corresponds to the colour produced by the test  
If there is no clue of that colour do not open any clue***

# Office of the Science Policy Advisor



## On-site Chemical Analysis Instruction Sheet



### Disclosure Pill



1. Transfer the disclosure pill from the vial labelled **P** to the "**S?2**" sample vial.
2. Secure the cap on to the "**S?2**" vial, mix the contents carefully by inversion (at least 10 times!).
3. Wait 1 minute for the colour in "**S?2**" to develop.

***Open the clue that corresponds to the colour produced by the test  
If there is no clue of that colour do not open any clue***



# Enter the Situation Centre Last...

- Return to Situation Centre, *only after visiting the other five locations*



## Situation Centre



**You will receive a bonus clue if  
you elect to run the test –  
however, there are both true  
and false bonus clues!**



### On-site Chemical Analysis Instruction Sheet

#### Fluorescence Intensity (Optional Clues)



The on-site analysis in this location will present you with a choice of one of two clues, which are provided to the inspection team by external sources. Do you trust the source? You can choose not to take the clue (which means there is no need to perform the test) or you can choose the clue that corresponds to the answer to the question below.

1. Shine the UV light (in the tip of the “invisible ink” pen) through each of the coloured solutions left over from the first five rooms.
2. Which solution has the highest intensity fluorescence? The answer you choose determines which of the two clues you will receive.

***Hold up your light stick to alert the inspection team that you  
have made a choice and they will provide you with the appropriate clue.***



Science For Diplomats at CSP-24 Presents:

# The Return of the Chemical Mystery

To win a prize:

1. **Shout louder and faster than anyone else...**
2. Blockchain must verify sequence of moves

and now the answers...

27 November 2019

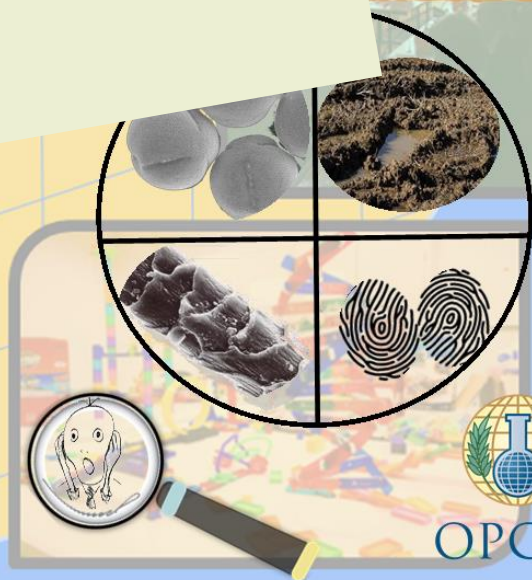
13:15-14:45

Europe Room, World Forum

Light Lunch available at 13:00



The... joins us to  
chemistry  
with advice  
y Working  
ve Science  
gy



OPCW



And the answer is?





# Did You Solve the Mystery?

## ■ Team #1 Clues:

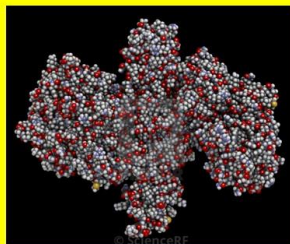
### Clue

A photograph from instruction booklet found at an unlicensed cosmetic clinic:



### Clue

An analysis of material collected at an unlicensed cosmetic clinic revealed the following molecular structure:



### Clue

A cosmetic clinic reported the theft of one of their products. An investigation is in progress. The product was stolen in the packaged form shown here:



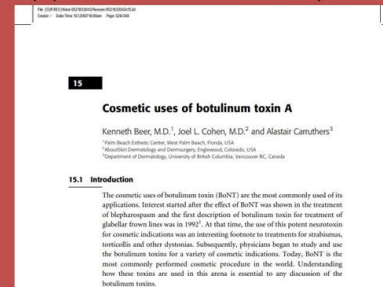
### Clue

An emergency room physician was interviewed and provided the following information regarding the admitted patient:

"The patient presented extreme swelling around regions of the eyes and mouth. The patient also displayed speech difficulties due to the swelling, as well as numbness around the upper portion of the throat region. On arrival, the patient demonstrated trouble breathing and suffered from hyperventilation. Once medicated, the patient's injuries were assessed as non-life threatening, and a course of antibiotics was prescribed in case of an infection."

### Clue

A scientific paper obtained from a medical library:



### BONUS

Photo of victim published by the media:



### BONUS

Photo of victim admitted to the hospital:

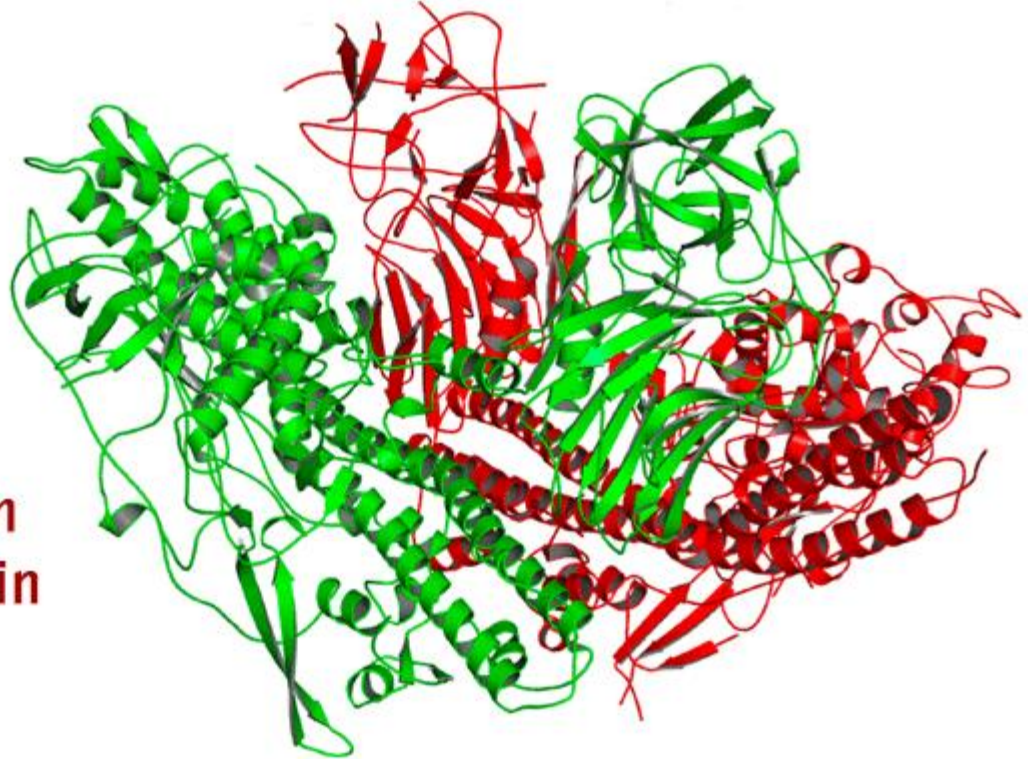


# Did You Solve the Mystery?

- Team #1



Botulinum  
Neurotoxin



***Provenance: stolen from a cosmetic clinic, label can trace back to supplier***

***Not intended to be a chemical weapon***



# Did You Solve the Mystery?

■ T

## storyline

An employee steals several cases of pharmaceutical grade botox from his employer, who owns a registered cosmetic clinic. The employee sets up their own clandestine cosmetic practice and attempts to use the botox products on customers who cannot afford to pay for the procedures at registered cosmetic clinics. However, the employee does not have the qualifications to perform the procedures safely, having only witnessed them at the employers clinic. Unfortunately, one of the procedures do not go according to plan and the client must go to the hospital.

Pr

tra

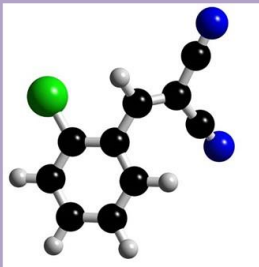
***Not intended to be a chemical weapon***

# Did You Solve the Mystery?

## Team #2 Clues:

### Clue

Illustration from the off-site analysis report:



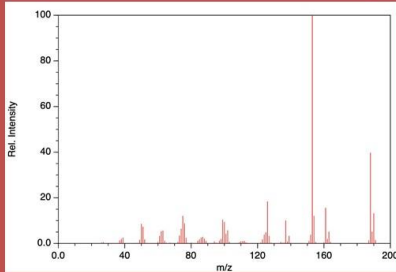
### Clue

Observations reported by the doctor include some of the symptom's indicated in this diagram. The doctor concluded the effects were transient:



### Clue

Laboratory analysis of material extracted from the clothing of the victim:



### BONUS

Other objects found at the incident site:



### Clue

Canisters found at the scene of the incident:



### Clue


Police storage warehouse where a burglary was recently reported:



### BONUS

From the label on the canisters found at the incident site:

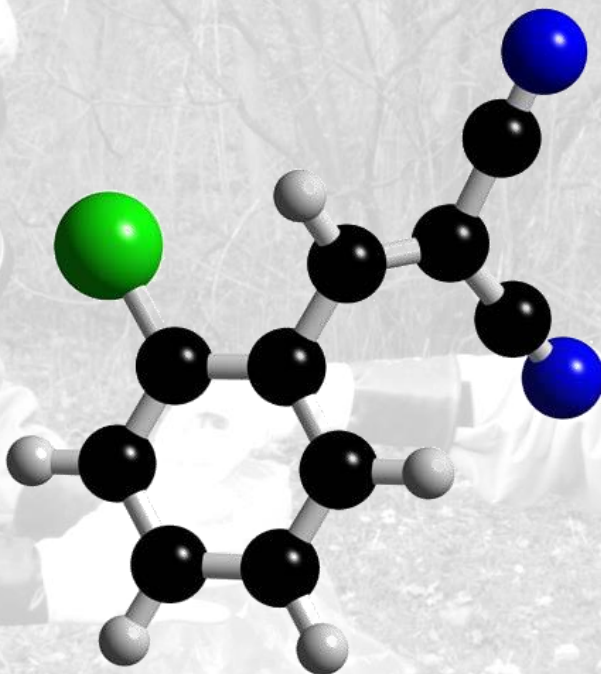
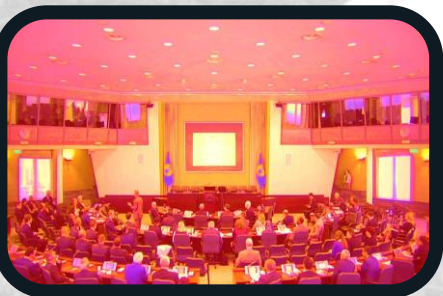
(Cont'd of page 1)

<b>Label elements</b>
<b>GHS label elements</b>
The product is classified and labeled according to the Globally Harmonized System (GHS).
<b>Hazard pictograms</b>

GHS02 GHS08 GHS07 GHS08
<b>Signal word</b> Danger
<b>Hazard-determining components of labeling:</b>
[2-chlorophenyl]methylphenylcarbamate
potassium chlorate
diphenylamine
potassium perchlorate
<b>Hazard statements</b>
H228 Flammable solid.
H301+H331 Toxic if swallowed or if inhaled.
H312 Harmful in contact with skin.
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H334 May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H317 May cause an allergic skin reaction.
H335 May cause respiratory irritation.



# Did You Solve the Mystery?

## ■ Team #2



2-chlorobenzaldehyde ("CS", tear gas)

**Provenance:** *stolen from a police warehouse, label can trace back to manufacturer*

**Not used for law enforcement:** *could be considered a chemical weapon*

# Did You Solve the Mystery?

■ T

## storyline

CS gas is disseminated at a local sports event. Victims suffer from mass tearing and eye irritation. A smaller group suffer from burning of their nose, mouth and throat, resulting in profuse coughing, nasal mucus discharge, disorientation, and difficulties breathing. CS gas cans are discovered on-site and surveillance footage identifies suspects. Upon investigation, law enforcement determines that a case of expired CS tear gas were stolen from a police storage facility and kept at a abandoned warehouse.

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ca

***Not used for law enforcement: could be considered a chemical weapon***

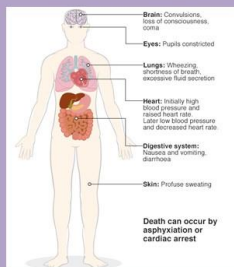


# Did You Solve the Mystery?

## Team #3 Clues:

### Clue

Observations reported by the doctor include some of the symptom's indicated in this diagram. The doctor concluded there was a neurotoxic event:



### Clue

The hiker admitted to the hospital had picked up these vials in the cave:



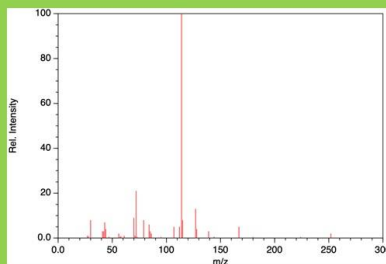
### Clue

A hiker exploring this cave was admitted to a hospital:



### Clue

Laboratory analysis from a wipe sample from the cave:



### Clue

The interior of the cave:



### BONUS

Photo of the interior of the cave reported in social media:



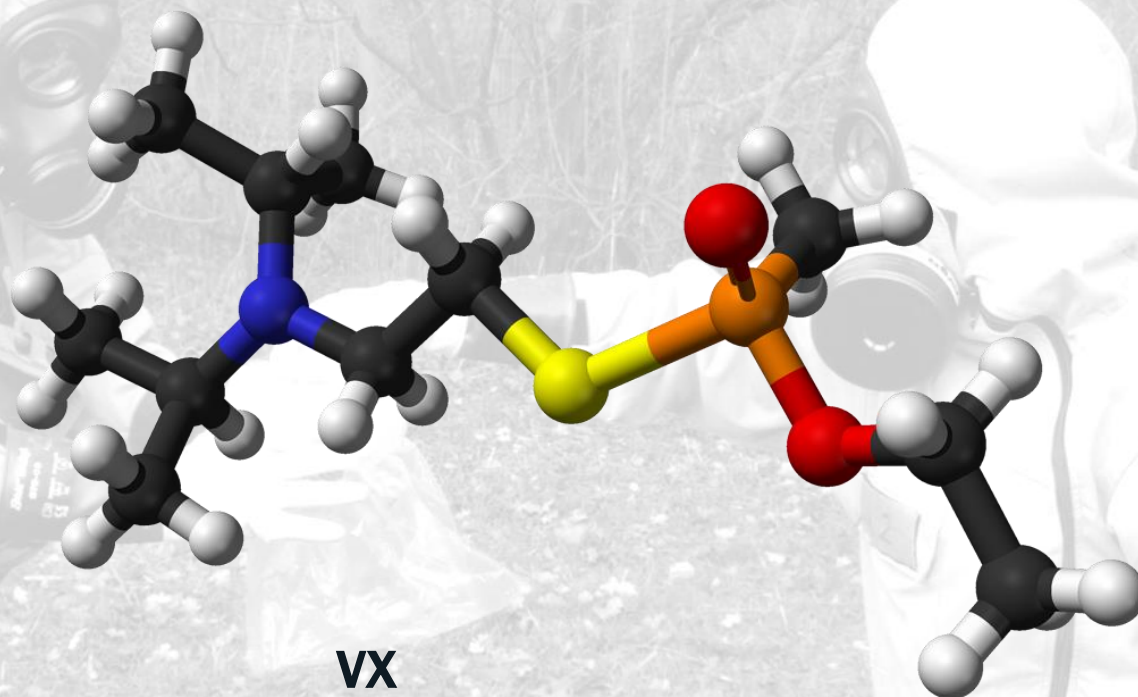
### BONUS

Photo from the laboratory that performed off-site analysis on samples retrieved from the cave:



# Did You Solve the Mystery?

## ■ Team #3



VX

**Provenance:** *produced in a clandestine laboratory (in the cave)*

**Appears to be produced as a chemical weapon (?)**



# Did You Solve the Mystery?

■ To solve the mystery

## storyline

Hikers in exploring remote mountains find a hidden cave and venture inside. They find an abandoned laboratory and hike back to call the police. Inside the cave the police find several vials containing a clear liquid, one of which seems to be leaking. One of the hikers said he picked up the vials and starts presenting signs and symptoms of nerve agent poisoning.

Pr

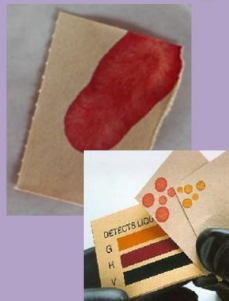
th

***Appears to be produced as a chemical weapon (?)***

# Did You Solve the Mystery?

## Team #4 Clues:

### Clue



On-site test results performed by emergency responders attending to injured sailors on the fishing boat upon return to port.

G = G nerve agents  
H = Vesicants  
V = V nerve agents

### Clue

Injuries developed by one of the fishing boat crew 18 hours following the discovery of the object:



### Clue

A fishing vessel retrieved this object from a location in the North Atlantic ocean. The crew believed to be Ambergis (a highly valued perfume ingredient produced by sperm whales).



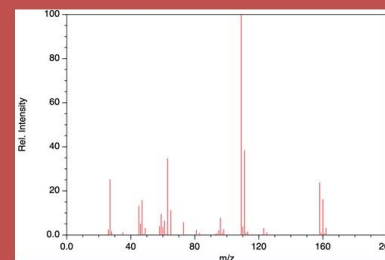
### Clue



Location of the fishing vessel.

### Clue

Laboratory analysis of the "Ambergis":



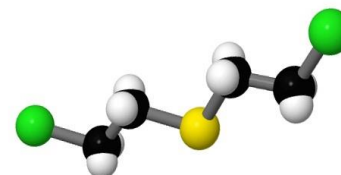
### BONUS

Also found leaking on the boat:



### BONUS

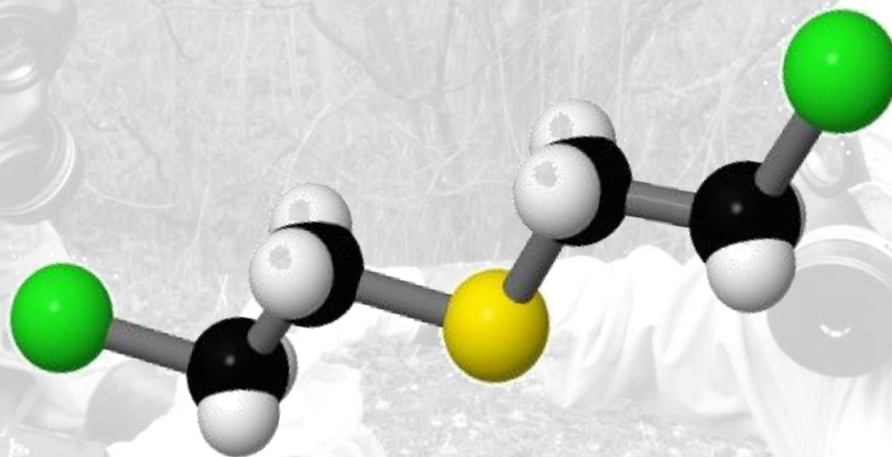
An illustration from the laboratory report of the off-site laboratory:





# Did You Solve the Mystery?

## ■ Team #4



**Sulfur Mustard**

**Provenance: *recovered from sea – origin unknown***

**A “sea dumped chemical weapon”**

# Did You Solve the Mystery?

■ To #4

## Storyline

While fishing in the North Atlantic, a fisherman pulls up a mustard nodule. Thinking it is highly valuable Ambergris from a sperm whale (\$35/gram), the fisherman sends it to an Ambergris broker hoping to sell it for perfume production. During transport, the package is damaged and attracts the attention of postal officials. A postal official develops blisters a day after examining the package.

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# Did You Solve the Mystery?

## ■ Team #5 Clues:

### Clue

On-site test kit used by investigators in the victims kitchen:



### Clue

Kitchen objects recovered from crime scene:



### Clue

Field of flowers near home of a victim of chemical exposure:



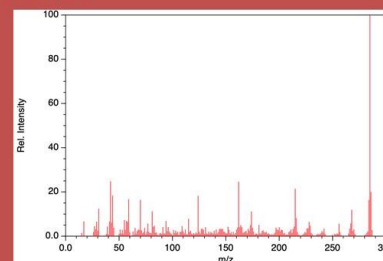
### Clue

An official police investigation report states that 50 poppy heads were stolen from the local poppy field. A spokesperson said the plants are being grown for commercial harvesting of medical products.



### Clue

Laboratory analysis of residue found in the mortar and pestle from the victims kitchen:



### BONUS

Poppies found at victims home:



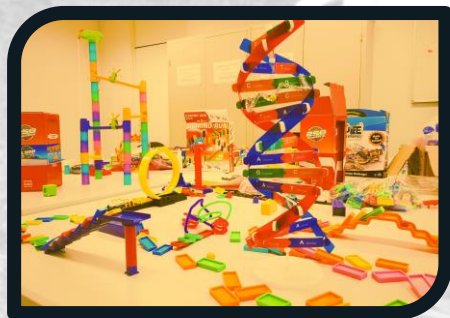
### BONUS

From an interview with a family member of the victim:

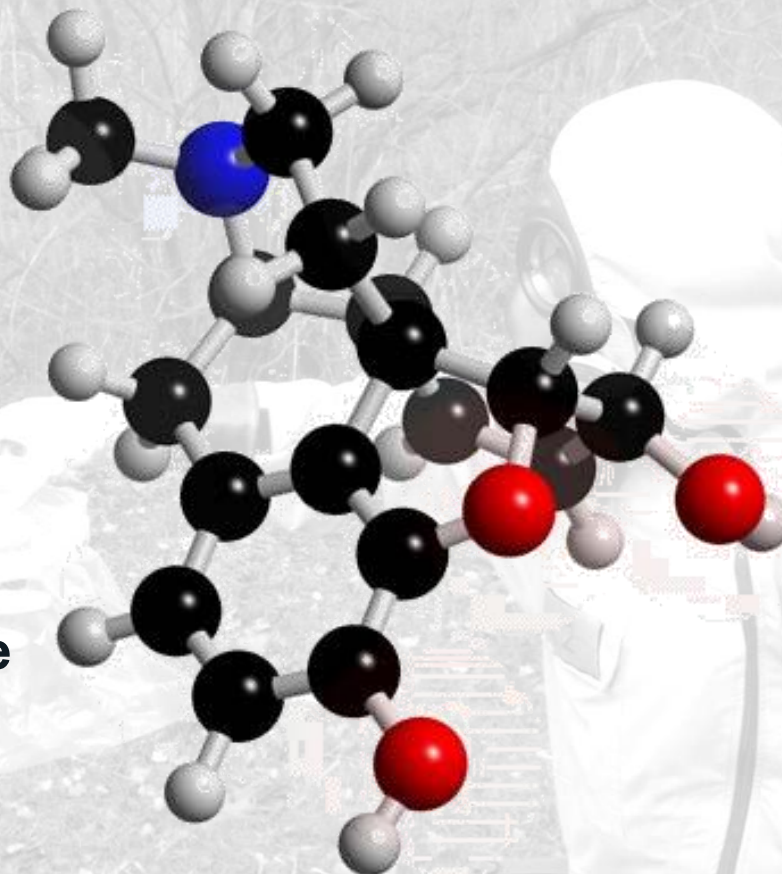
The victim's sister confessed she had cut open poppies and used resin from the pod to make tea for her brother. She indicated her brother owed her money.

# Did You Solve the Mystery?

## ■ Team #5



Morphine



**Provenance: *from the poppy field***

***Used as a toxic chemical, is it a chemical weapon?***



# Did You Solve the Mystery?

■ To

## storyline

Investigating a suspicious overdose, experts deduce that morphine was extracted from poppies by a family member who regularly prepared meals for the victim. The poppies were brewed and served as tea. The plants were stolen from the local opium field which is run by the government to produce pharmaceutical grade morphine.

Pr

Us

# What is Next for the Scientific Advisory Board?



- **SAB will review and endorse TWG report (in progress)**
- **One meeting in 2020, date TBD**



# New Scientific Advisory Board Leadership for 2020



- **Dr Christophe Curty (Chair)**
- **Dr Zrinka Kovarik (Vice-Chair)**  
Recipient of 2018 State Science  
Award from the Croatian Parliament

# Reflections of a Departing Science Adviser





# Reflections





# Reflections

## CONVERGENCE OF CHEMISTRY AND BIOLOGY

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

JUNE 2014



## VERIFICATION

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



## 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

Working Together For a World Free of Chemical Weapons



ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

### Temporary Working Group on Investigative Science and Technology

Reporting to the Scientific Advisory Board (SAB), the Temporary Working Group (TWG) will in particular consider the following questions:

#### Question 1:

Which methods and capabilities used in the forensic sciences could usefully be developed and/or adapted for Chemical Weapons Convention-based investigations?



#### Question 2:

What are the best practices and analysis tools used in the forensic sciences for effectively cross-referencing, validating and linking together information related to investigation sites, materials collected/analysed, and individuals interviewed?



#### Question 3:

What are the best practices for management of data collected in investigations, including compilation, curation, and analysis?



#### Question 4:

What are the best practices for the collection, handling, curation and storage, and annotation of evidence?



#### Question 5:

Which technologies and methodologies (whether established or new) allow point-of-care and non-destructive measurements in an investigation site to help guide evidence collection?



#### Question 6:

Which technologies and methodologies (whether established or new) can be used in the provenance of chemical and/or material samples collected in an investigation?



#### Question 7:

Which methods are available (or are being developed) for the sampling and analysis of environmental and biomedical materials and can be used in the detection of toxic industrial chemicals relevant to the Chemical Weapons Convention?



#### Question 8:

Which technologies and methodologies (whether established or new) can be used to ensure the integrity of digital images and video recordings?



#### Question 9:

Which technologies and methodologies (whether established or new) can be used to ensure the integrity of an investigation site?



#### Question 10:

Do collections of physical objects, samples, and other information for chemical weapons-related analysis exist and can they be made available to investigators for retrospective review? How might these collections be used to support investigations?



#### Question 11:

Are there stakeholders that the Technical Secretariat could usefully engage with to leverage their capabilities on investigative matters?



#### Question 12:

In addition, the TWG will provide advice on Technical Secretariat proposals for methodologies, procedures, technologies, and equipment for investigative purposes.



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/opcwonline



/opcwonline



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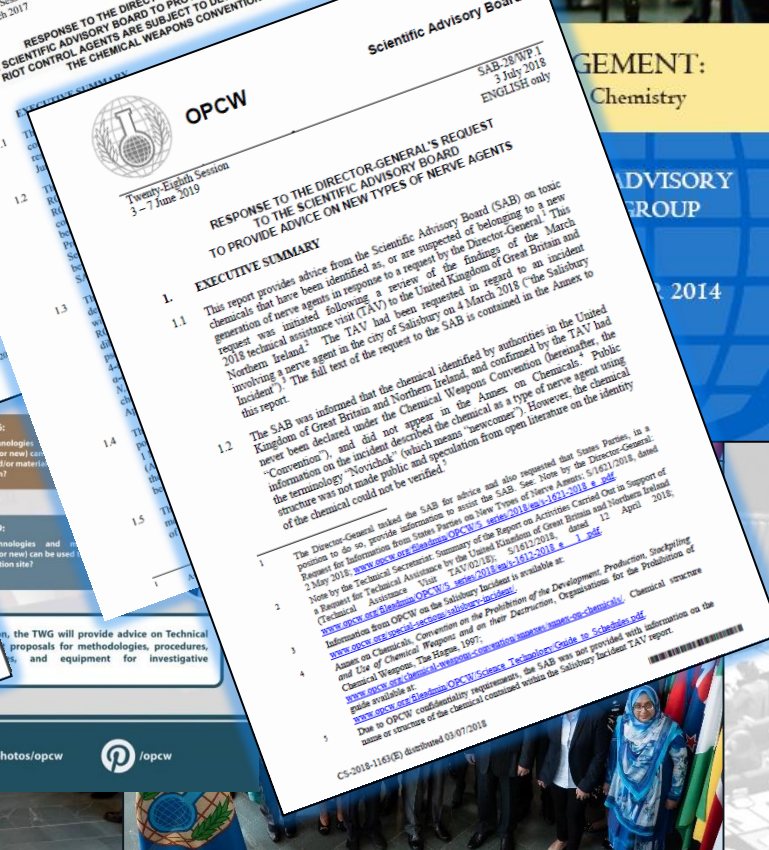
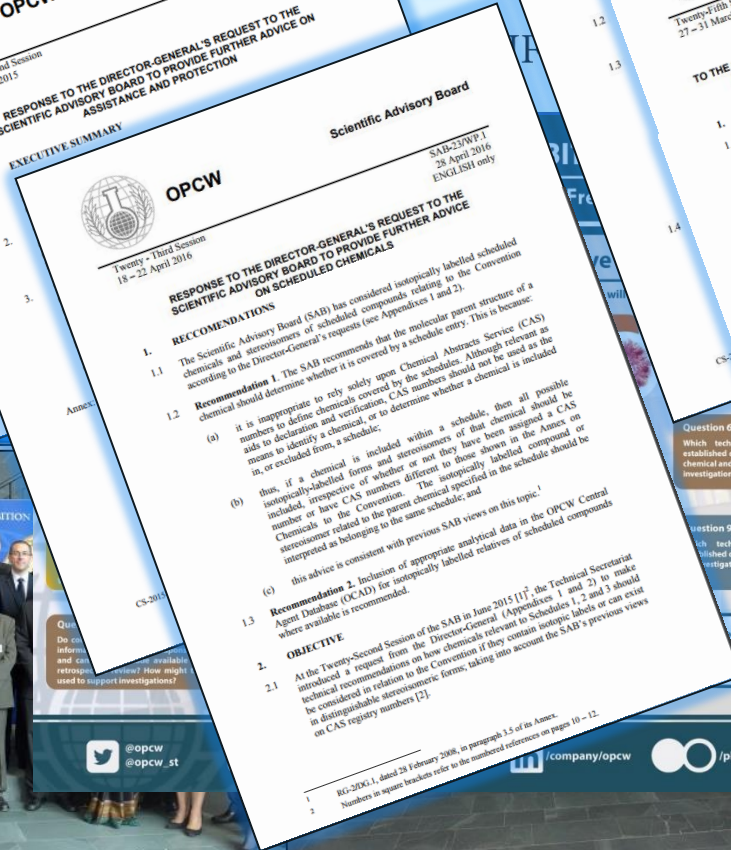
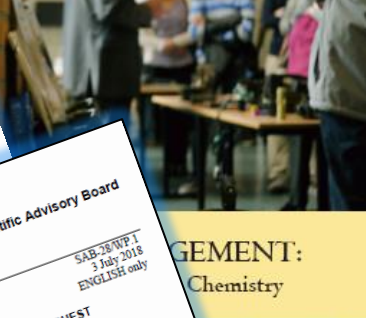
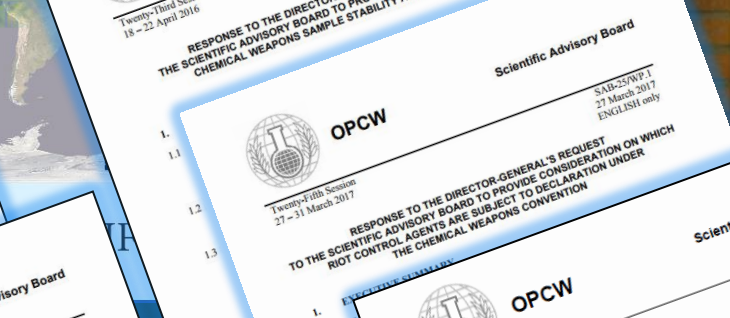
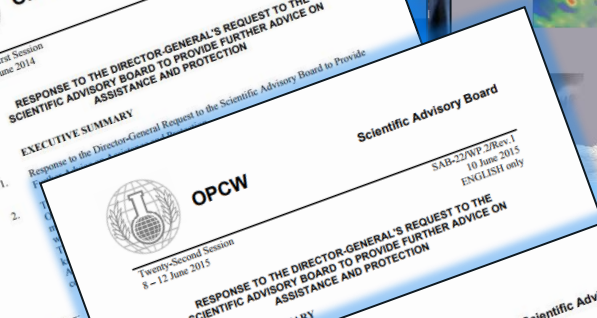
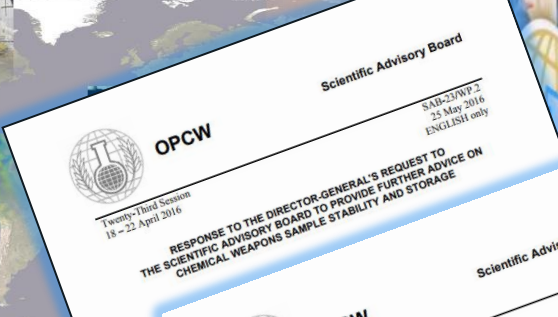
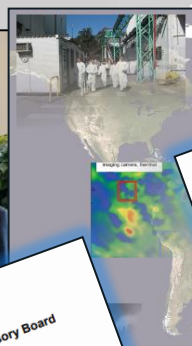
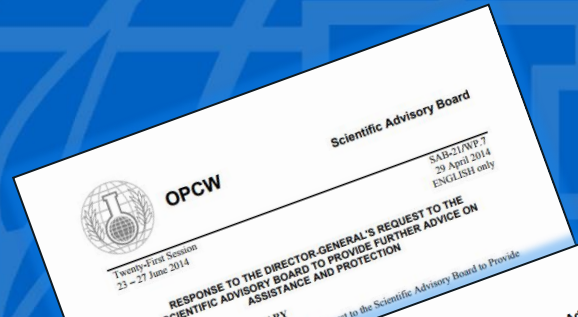


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Reflections





# Reflections



## Chemical Forensics: Capabilities across the Field and the Potential Applications in Chemical Weapons Convention Implementation

Helsinki, Finland. 20 to 22 June 2016

SAB-24/WP.1, dated 14 July 2016, URL: <http://q-r.to/bap1gy>

Coorganizer: VERIFIN



## Chemical Warfare Agents: Toxicity, Emergency Response and Medical Countermeasures

Paris, France. 26 to 27 September 2016

SAB-24/WP.2, dated 14 October 2016, URL: <http://q-r.to/bap1h4>

Coorganizer:

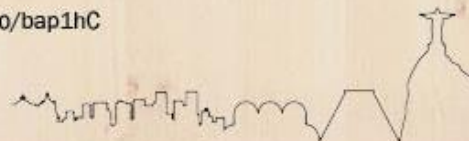


## Innovative Technologies for Chemical Security

Rio de Janeiro, Brazil. 3 to 5 July 2017

SAB-26/WP.1, dated 21 July 2017, URL: <http://q-r.to/bap1hC>

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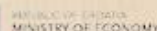
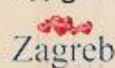


## International Workshop on Trends in Chemical Production

Zagreb, the Republic of Croatia. 3 to 5 October 2017

SAB-26/WP.2, dated 19 October 2017, URL: <http://q-r.to/bap1hD>

Coorganizers:



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CS-2018-1163(D) disclosed 03/07/2018



# Reflections



## Chemical Forensics: Capabilities across the Field and the Potential Applications in Chemical Weapons Convention Implementation

Helsinki, Finland. 20 to 22 June 2016

SAB-24/WP.1, dated 14 July 2016, URL: <http://q-r.to/bap1gy>

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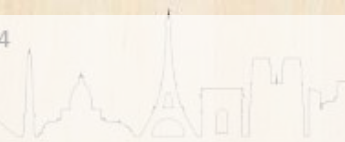


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Coorganizer:



## Innovative Technologies for Chemical Security

Rio de Janeiro, Brazil. 3 to 5 July 2017

SAB-26/WP.1, dated 14 July 2017, URL: <http://q-r.to/bap1h5>

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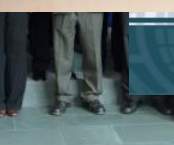
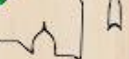
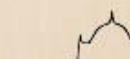
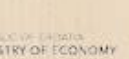
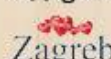


## International Workshop on Trends in Chemical Production

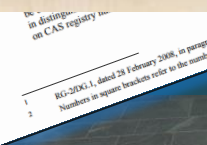
Zagreb, the Republic of Croatia. 3 to 5 October 2017

SAB-26/WP.2, dated 19 October 2017, URL: <http://q-r.to/bap1hD>

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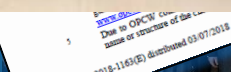
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# Science for Diplomats

2014



2016



2018



2015



2017



2019

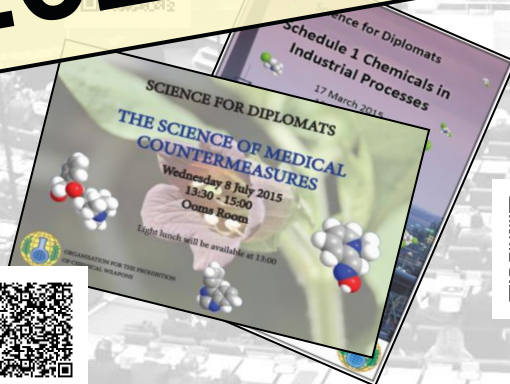




# Science for Diplomats



24 Events from June  
2014 to November 2019



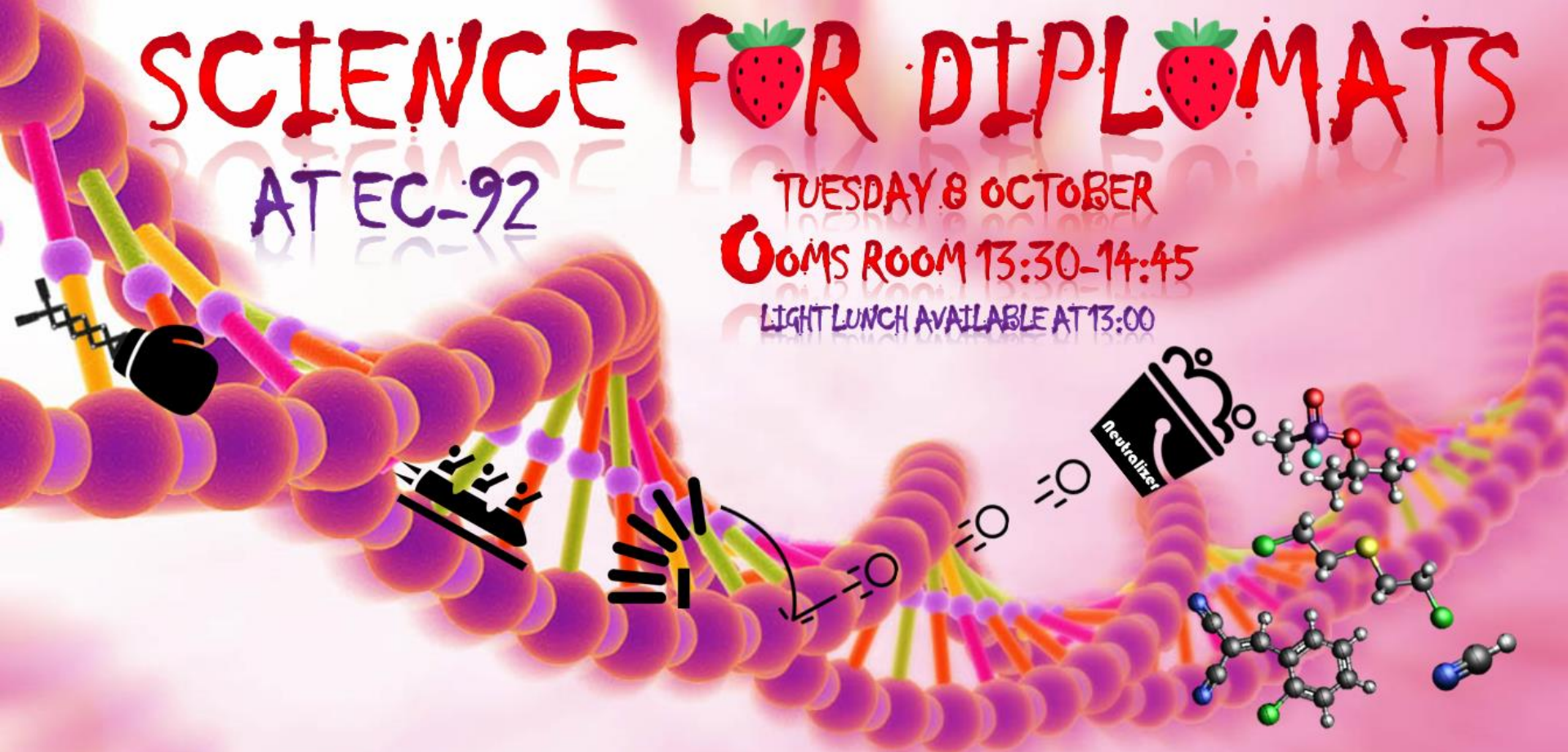


# SCIENCE FOR DIPLOMATS

ATEC-92

TUESDAY 8 OCTOBER  
COMS ROOM 13:30-14:45

LIGHT LUNCH AVAILABLE AT 13:00



## CHEMICAL ACTION

## LIFE PROCESSES

*An exploration of the systems biology of toxic  
chemicals with a hands-on DNA experience!*



OPCW



# WORKSHOPS FOR DIPLOMATS

TUESDAY 8 OCTOBER  
COMS ROOM 13:30-14:45  
LIGHT LUNCH AVAILABLE AT 13:00



LI  
An exploration  
of chemistry with a hands-on DNA experience!



# OUTREACH FOR DIPLOMATS

ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS



An exploration of  
chemicals with a hands-on DNA experience!



In Honour of the International Year of the Periodic Table of Chemical Elements 2019

In Honour of the International Year of the Periodic Table of Chemical Elements 2019

**Order of Entry into Force**

**Country Element**

**Country Symbol**

**Date of Deposit**

**LEGEND**

- Western Europe and Other States (WEOG)
- Eastern Europe
- Africa
- Latin America and the Caribbean (GRULAC)
- Asia

**2019 IYPT**

United Nations Educational, Scientific and Cultural Organization

International Year of the Periodic Table of Chemical Elements



# Periodic Table of States Parties to the Chemical Weapons Convention

In Honour of the International Year of the Periodic Table of Chemical Elements 2019

In Honour of the International Year of the Periodic Table of Chemical Elements 2019

1 SE Swedenium 17/06/1993																	2 NO Norwegium 07/04/1994						
3 AU Australium 06/05/1994	4 ES Espanium 03/08/1994																	5 BG Bulgarium 10/08/1994	6 DE Deutschium 12/08/1994	7 MX Mexicovium 29/08/1994	8 GR Grecium 22/12/1994	9 RO Romanium 15/02/1995	10 FR Frenchium 02/03/1995
11 HR Hrvatsium 23/05/1995	12 MC Monacovium 01/06/1995																	13 DZ Algerium 14/08/1995	14 AT Osterreichium 17/08/1995	15 PL Polisovium 23/08/1995	16 JP Japanium 15/09/1995	17 CA Canadiium 26/09/1995	18 AR Argentinium 02/10/1995
19 NA Nambium 24/11/1995	20 IT Italium 08/12/1995	21 CI Cote d'Ivorium 18/12/1995	22 MA Morocovium 28/12/1995	23 BR Brazilium 13/03/1996	24 GB Britanium 13/05/1996	25 MD Moldovium 08/07/1996	26 PT Portugalium 10/09/1996	27 HU Hungarium 31/10/1996	28 PH Philippinium 11/12/1996	29 BE Belgium 27/01/1997	30 LU Luxemburgium 27/01/1997	31 TN Tunisium 15/04/1997	32 TG Tongovium 23/04/1997	33 CN Chinatum 25/04/1997	34 US Americanium 25/04/1997	35 ZW Zimbabwium 25/04/1997	36 IS Icelandium 28/04/1997						
37 ML Malium 28/04/1997	38 MT Maltavium 28/04/1997	39 FJ Fijium 20/01/1993	40 MU Mauritium 09/02/1993	41 AL Albanium 11/05/1994	42 CK Cook Islandium 15/02/1994	43 LK Sri Lankium 19/08/1994	44 PY Paraguayium 01/12/1994	45 TJ Tajikistanium 11/01/1995	46 MN Mongolium 17/01/1995	47 FI Finlandium 07/02/1995	48 CH Switzerland 10/03/1995	49 NL Netherlandium 30/06/1995	50 DK Denmarkium 13/07/1995	51 PE Peruvium 20/07/1995	52 EC Ecuadorium 06/09/1995	53 ZA South Africa 13/09/1995	54 SK Slovakium 17/10/1995						
55 SV El Salvadorium 30/10/1995	56 GE Georgium 27/11/1995	57 CZ Czechium 06/03/1996	72 UY Uruguayium 06/10/1994	73 KE Kenyatium 24/07/1994	74 SA Saudia Arabium 09/08/1998	75 OM Omanium 08/02/1995	76 BH Bahrainium 28/04/1997	77 AM Armenium 27/01/1997	78 LC Saint Lucium 09/04/1997	79 LV Latvium 23/07/1996	80 LA Laovium 25/02/1997	81 SZ Eswatinium 20/11/1996	82 MV Maldivium 31/05/1994	83 TM Turkmenistanium 25/02/1996	84 LS Lesothium 12/12/1994	85 LZ Liberium 07/09/1996	86 BA Bosnium 25/02/1997						
87 SR Surinamium 28/04/1997	88 CU Cubatum 29/04/1997	89 TR Turkium 22/05/1997	104 RU Russium 05/11/1997	105 NP Nepalium 18/11/1997	106 VE Venezuelium 03/12/1997	107 MR Mauritanium 09/02/1998	108 LT Lithuanium 15/04/1998	109 BJ Beninium 14/05/1998	110 GM Gambium 19/05/1998	111 MW Malawium 11/06/1998	112 TZ Tanzaniam 11/06/1998	113 SN Senegium 11/06/1998	114 BO Boliviium 11/06/1998	115 BR Braziliium 11/06/1998	116 PY Paraguayium 11/06/1998	117 EC Ecuadorium 11/06/1998	118 VN Vietnamium 30/09/1998						
119 PA Panamanium 07/10/1998	120 UA Ukrainium 14/10/1998	121 ID Indonesium 12/11/1998	136 MZ Mozambicium 15/08/2000	137 KI Kiribatum 07/09/2000	138 GA Gabonium 08/09/2000	139 JM Jamaicium 08/09/2000	140 YE Yemenium 08/09/2000	141 YE Yemenium 08/09/2000	142 YE Yemenium 08/09/2000	143 YE Yemenium 08/09/2000	144 YE Yemenium 08/09/2000	145 YE Yemenium 08/09/2000	146 YE Yemenium 08/09/2000	147 YE Yemenium 08/09/2000	148 TH Thailandium 10/12/2002	149 PW Palauvium 05/02/2003	150 GT Guatemalium 12/02/2003						
151 AD Andorium 27/02/2003	152 TL Timor Lestium 07/05/2003	153 TO Tongovium 29/05/2003	168 NI Nicaragium 08/09/2000	169 NI Nicaragium 08/09/2000	170 NI Nicaragium 08/09/2000	171 NI Nicaragium 08/09/2000	172 NI Nicaragium 08/09/2000	173 NI Nicaragium 08/09/2000	174 NI Nicaragium 08/09/2000	175 CD Democovium 09/02/2001	176 DJ Djiboutium 21/01/2006	177 HT Haitium 22/02/2006	178 LR Liberium 23/02/2006	179 ME Montenegrium 15/04/1998	180 KM Comorovium 18/08/2006	181 CF Centrafri 21/01/2006	182 BB Barbadosium 07/03/2007						
183 CG Congovium 04/12/2007	184 GW Guineabisiium 20/05/2008	185 LB Lebanonium 20/11/2008	59 ET Ethiopiium 13/05/1996	60 CR Costaricium 31/05/1996	61 IE Irelandium 24/06/1996	62 BY Belarusium 11/07/1996	63 CL Chilium 12/07/1996	64 NZ Aotearoovium 15/07/1996	65 IN Indium 03/09/1996	66 CM Cameroonium 16/09/1996	67 NE Nigeratium 09/04/1997	68 BD Bangladium 25/04/1997	69 GQ Equatorial Guinium 25/04/1997	70 KR Koreatium 28/04/1997	71 SC Seychellium 07/04/1993								
90 SG Singaporium 21/05/1997	91 KW Kuwaitium 29/05/1997	92 GN Guinium 09/06/1997	93 SI Slovenium 11/06/1997	94 MK Macedoniam 20/06/1997	95 TT Trinidadium 24/06/1997	96 BF Burkina Fasiium 08/07/1997	97 GH Ghanium 09/07/1997	98 BN Bruneium 28/07/1997	99 QA Qatarium 03/09/1997	100 GY Guyanum 12/09/1997	101 PK Pakistanium 28/10/1997	102 JO Jordanium 29/10/1997	103 IR Iranacium 03/11/1997										
122 VA Vaticanium 12/05/1999	123 NG Nigerium 20/05/1999	124 SD Sudanum 24/05/1999	125 EE Estonium 26/05/1999	126 FM Micronesium 21/06/1999	127 NI Nicaragium 05/11/1999	128 LI Liechtensteinium 24/11/1999	129 SM Sanmarinum 10/12/1999	130 ER Eritrium 24/02/2000	131 AZ Azerbaijanium 29/02/2000	132 KZ Kazakhstanium 23/03/2000	133 CO Colombium 05/04/2000	134 MY Malaysium 20/04/2000	135 RS Serbiium 20/04/2000										
154 AF Afghanistanium 24/09/2003	155 ST Sactium 09/09/2003	156 KG Kyrgyzstanium 29/09/2003	157 CV Carbovovium 10/10/2003	158 BZ Belizeium 01/12/2003	159 LY Libyatium 06/01/2004	160 TV Tuvalum 19/01/2004	161 TD Chadum 13/02/2004	162 RW Rwandum 31/03/2004	163 MH Marshallium 19/05/2004	164 KN Kittsnevisium 21/05/2004	165 SB Solomonium 23/09/2004	166 SL Sierra Leonium 30/09/2004	167 MG Madagas Carium 20/10/2004										
186 IQ Iraqium 13/01/2009	187 DO Dominicanium 27/03/2009	188 BS Bahamasium 21/04/2009	189 SO Somallium 29/05/2013	190 SY Syrium 14/09/2013	191 MM Myanmarium 06/07/2015	192 AO Angolium 16/09/2015	193 PS State of Palestinium 17/05/2018																

Order of Entry into Force

Country Element

Country Symbol

Date of Deposit

1

H

Hydrogen

dd/mm/yyyy

LEGEND

Western Europe and Other States (WEOG)


Eastern Europe

Africa

Latin America and the Caribbean (GRULAC)

Asia


Thank you all for the fantastic support!



OPCW



United Nations Educational, Scientific and Cultural Organization





2019 IYPT



International Year of the Periodic Table of Chemical Elements

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# One Last Thing...



**Mr Cheng Tang**  
**2019 SAB Chair**  
**2015 – 2018 SAB Vice-Chair**

**8 Sessions of the SAB**  
**Served on 2 TWG's**  
**4 International SAB Workshops**

**Led on 1 intersessional report**  
**1 OPCW-Hague Award!**

**#IamaScienceDiplomat**



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