



The OPCW Science & Technology Monitor

Volume 3 Number 3

A sampling of Science & Technology
Relevant to the Chemical Weapons Convention

6 July 2016

In this Issue



Image courtesy of Brian Jones.

**Medicines, Drugs
and Incapacitants:
CNS Acting
Chemicals**



Image courtesy of Tej3478.

**Artificial
Intelligence**

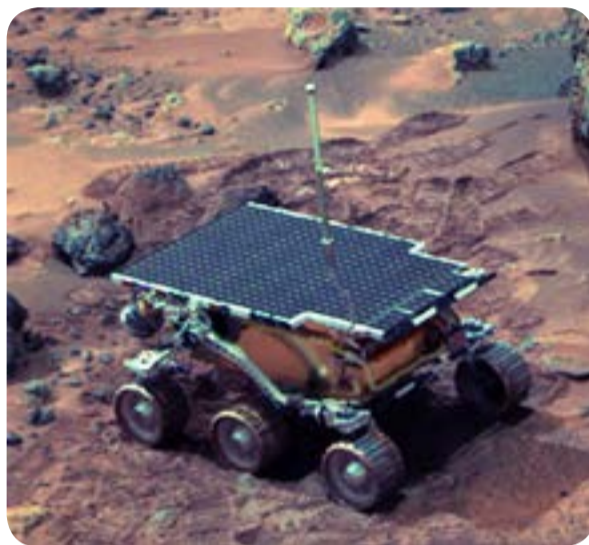


Image © OPCW.

**SAB, ABEO and
OPCW Day reports**

Welcome

Welcome to the OPCW Science and Technology Monitor, an occasional bulletin providing updates on developments in science and technology across a broad spectrum of topics relevant to the CWC. Past issues (and more) can be found on the [Science and Technology section of the OPCW website](#).



The Mars rover Sojourner (left) and a Micro Air Vehicle (right) going on reconnaissance missions near The Dice (Mars) and China Lake (Earth).
Images courtesy of [NASA](#) and [U.S. Navy](#).

This third issue of 2016 comes on the 19th anniversary of the day that [Mars rover Sojourner became the first man-made vehicle to travel across the surface of another planet](#). [Sojourner was designed to operate for one week](#), yet operated and produced data for nearly three months. Today on Earth, [autonomous vehicles](#) (many larger and equipped with more instruments than Sojourner) are becoming more and more commonplace. In the spirit of the Mars rovers, autonomous systems that can collect and transmit information (including from environments dangerous to humans) open up many [opportunities for scientific applications](#) and even for [detecting chemical weapons!](#)

The S&T Puzzle

Congratulations go out to our first puzzle winner from OPCW's International Cooperation and Assistance Division (ICA). One of the ICA's interns took the prize on what he described as a "befuddling task". Puzzle statistics now stand at: VER 6, CTBTO 5, OSP 2, OCS 1, INS 1 and ICA 1. The answers can be found on the last page!

For this edition of the puzzle, we challenge you to recognize the "Sounds of the OPCW". The first person to correctly identify the five below wins the prize: your choice of requesting a featured topic, designing a puzzle or receiving a beverage hand selected by the Science Policy Adviser. Send answers to scitech@opcw.org. Good luck!



- [Sound 1](#)
- [Sound 2](#)
- [Sound 3](#)
- [Sound 4](#)
- [Sound 5](#)

Science Fun

Behind every issue of our S&T Monitor, from the selection of topics to the design of graphics and especially for the puzzle, there is much laughter to be heard! So much laughter in fact, that several colleagues have questioned whether or not we are actually doing science or just simply [studying laughter](#).



We are of course doing science, it is called “[gelotology](#)”, it makes you laugh and there are actually [experiments](#) you can do at home for both [a good laugh](#) and to advance the field (which, by the way, [needs input from laughing babies](#)). You must also realise that laughing is not easy, that’s right, our laughing staff are hard at work! Laughing can actually [increase your energy expenditure and heart rate by as much as 20%](#)! If you are not convinced, take a look at how much [work was required to find the world’s funniest joke](#)! Perhaps more importantly, laughing is [good for cardiovascular health](#), can [reduce mortality](#) for those suffering from certain diseases and can [help in the treatment of dementia](#). With this in mind, we thought that science fun could give you a few things to laugh about to ensure good health, bearing in mind that [laughing is a complicated neural and biochemical process](#) (this

News and Updates

Recent reports and publications:

2015 Annual Reports from [Spiez Laboratory](#) and [Lawrence Livermore National Laboratory](#) (OPCW Designated Laboratories).

[Report of the Forty-Third Meeting](#) of the Validation Group for the Updating of the OPCW Central Analytical Database, 30 and 31 March 2016

[Progress Report on the Use of Sampling and Analysis During OPCW Industry Inspections](#)

[May 2016 issue](#) of Dstl’s inSIGHT

[R&D Funding and performance in the OECD area and beyond](#) (report and [indicators](#))

[Nature Index looks at science in Saudi Arabia](#)

WIPO [2016 review of patent cooperation treaty](#)

WIPO Methodologies for the Development of National Intellectual Property Strategies Toolkit: [Process](#), [Baseline Survey](#) and [Indicators](#)

[Patent landscape on microalgae-related technologies](#)

Documents from the WIPO [seminar on intellectual property and genetic resources](#)

[Interim report of the Preparatory Committee](#) Meeting for the Eighth Review Conference of the Biological Weapons Convention.

A Harvard Sussex program Occasional paper that looks at [why the Geneva Protocol came to include bacteriological warfare](#).

Science advice and review proposals and papers from the BWC Preparatory Committee Meeting submitted by [Finland, Norway and Sweden](#); [The Russian Federation](#); [Switzerland](#); [The United Kingdom of Great Britain and Northern Ireland](#); and [The United States of America](#)

Report from FAS on [Use of Attribution and Forensic Science in Addressing Biological Weapons Threats](#)

Biochem Security 2030 report: [A Decade of Synthetic Biology in the Context of the Biological and Toxin Weapon Convention and the Chemical Weapon Convention](#)

[Draft report](#) of NATO’s meeting on the use of airborne intelligence, surveillance, and reconnaissance

[Transcript of the coordinators meeting](#) of IAEA Technology Foresight for Safe-Guards instruments

May 2016 [International Council for Science \(ICSU\) Newsletter](#)

June 2016 issue of [Science Policy Africa](#)

A look at how [world leaders use social media](#) and the [online ecology of adversarial aggregates](#) (a study on [what social media can teach us about terrorist activity](#))

Some news from the world of science and technology:

From the weeks of [10 – 16](#), [17 – 23](#), and [24 – 30](#) April; [1 – 7](#), [8 – 14](#), [15 – 21](#), and [22 – 28](#) May; [29 May – 4 June](#); and, [5 – 11](#), [12 – 18](#), and [19 – 25](#) June; and [26 June to 2 July](#) 2016 in chemistry.

begs the question, is laughter a type of CNS-Acting agent with dual use potential?).

Complicated [scientific explanations](#) and the use of [functional magnetic resonance imaging to study laughter](#) aside, people have been attempting to [explain and understand laughter](#) and what it does for us for centuries. [Laughing has been explained](#) as important for [relieving stress](#), as a [defensive mechanism](#), and even as [playing a role in human reproduction](#) (some have suggested this is why early humans needed humour, although the study we cite shows the [benefits of laughter to those undergoing IVF treatments](#)). Being humorous may actually be an indicator of other valuable traits, such as [intelligence](#). Are talented comedians the smartest people?

Laughter can be used as [a means of pain relief](#). [Norman Cousins](#), known for his work in [nuclear disarmament](#) and world peace, discovered after being [diagnosed with reactive arthritis](#), that combined with a large intravenous dose of vitamin C, 10 minutes of belly laughter provided him with approximately 2 hours free from pain, before needing to have another good guffaw.

You might have read somewhere that laughing is an excellent way of burning some of those irksome calories. While this is certainly possible, the amount of laughing required to burn enough calories to be considered “beach ready” might have you declared insane (or obsessive-compulsive at best!). Take for an example a cheese sandwich of around 497 calories, [if you can burn 10-40 calories for every 10-15 minutes](#)

Science and education tools and resources:

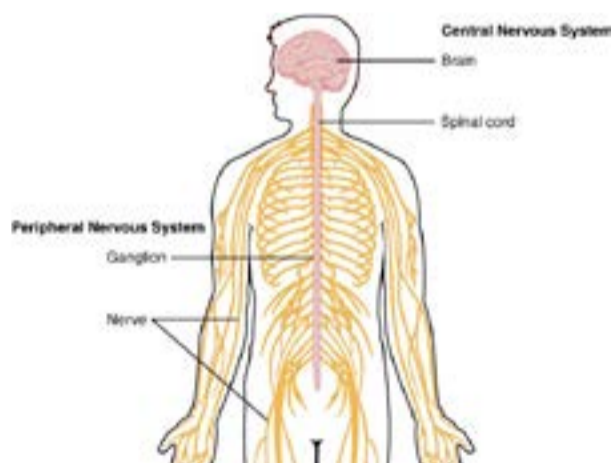
Papers from the [2016 Spring ConfChem](#): (1) Education, outreach and the OPCW: growing partnerships for a global ban; (2) Education and Engagement: Key Elements to Achieve a World Free of Chemical Weapons; (3) Mainstreaming Multiple Uses of Chemicals in Chemistry Teacher Education Programs of Africa; (4) The Project Irresistible: Introducing Responsible Research and Innovation into the Secondary School Classroom; (5) Citizen Science and International Collaboration through Environmental Monitoring with Simple Chemical Sensors; (6) Painful Chemistry! From Barbeque Smoke to Riot Control; and, (7) Sampling and Analysis of Organophosphorus Nerve Agents: Analytical Chemistry in International Chemical Disarmament

[Science education resources](#) from Science Friday

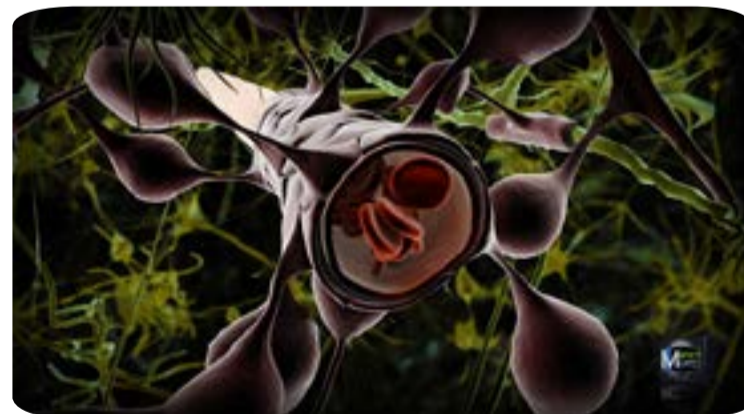
[The Hague Ethical Guidelines](#) have been [endorsed by IUPAC](#) and served as inputs to the [Global Chemists Code of Ethics](#)

Medicines, Drugs of Abuse and Incapacitants: Central Nervous System (CNS) Acting Chemicals

Central Nervous System (CNS) acting chemicals is a term used to refer to [agents](#), that can induce [incapacitating effects](#) (given a suitable dosage or exposure), they additionally do not meet the criteria to be a [riot control agent \(RCA\)](#). [Riot control agents](#) under the [Chemical Weapons Convention](#) are defined as “any chemical not listed in a Schedule, which can produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following termination of exposure”. The OPCW SAB has previously looked at technical dimensions of CNS acting agents, a summary of conclusions and recommendations from this work can be found under [Agenda Item 11 of the report from their Twenty-Third Session](#). CNS acting chemicals were also the subject of a recent paper submitted to the [Twentieth Session of the Conference of the States Parties](#), in which 23 States expressed concerns over the use of [aerosolized CNS acting agents for law enforcement purposes](#). Likewise, [concerns about weaponization of incapacitating chemicals](#) are frequently [discussed by non-proliferation experts](#). Many chemicals exert their effects on the CNS and they include chemicals used as medicines and/or drugs of abuse.



Left: Schematic view of the Central and Peripheral Nervous System. Bottom: Artist's view of the Blood Brain Barrier, including blood cells (red), astrocytes (grey) and neurons (green). Images courtesy of [OpenSTAX](#) and [Ben Brahim Mohammed](#).



The nervous system is made up of two subparts: [the CNS](#) which includes the brain and spinal cord, and the [peripheral nervous system](#) which encompasses the nerves extending from the spinal cord. The CNS integrates sensory information collected by the peripheral nervous system, responding to this information by coordinating both conscious and unconscious activity (such as blinking). For medications to produce an effect, a CNS acting chemical must penetrate [the blood-brain barrier \(BBB\)](#), a highly regulated interface separating peripheral circulation and the CNS. It functions as a selective diffusion barrier, controlling molecular transport to the brain. The impermeable nature of the BBB presents a [challenge for drug development](#), requiring great attention be given to “[brain penetration](#)” and how to deliver the drug. Drug delivery strategies can include oral, intravenous, [intranasal](#), ([targeted](#)) [nanoparticle](#), [dendrimer](#), [cell-penetrating peptide](#) and even [ultrasound](#) based methods.

of [non-stop laughing](#), it would take anywhere from 124 - 745 minutes, or up to twelve hours of nothing but laughing, to burn it off.

[John Morreall](#), the founder of the journal [Humor: International Journal of Humor Research](#), suggests that the origin of laughter comes from a shared expression of relief from passing danger, in the early stages of the development of the human species. [Friedrich Nietzsche](#) however, had a more cheerful outlook on the whole thing, [suggesting that laughter is nothing more than a reaction to the inevitable sense of existential loneliness and mortality unique to humanity](#). Yet it seems that Nietzsche may have been wrong, as it is not just humans who



laugh, [rats](#) and even [dogs and chimpanzees](#) might be laughing too (maybe they are existentially lonely as well?). In case you need it, there are published procedures on [how to tickle rats](#) (who in turn produce high-pitched laughter that requires specialised equipment to hear). Why tickle rats? Why [breed them to be better laughers](#)? Maybe to raise healthy and happy rats? Or perhaps just to gain [new insights into neurogenesis](#) or to [model primal human laughter](#)?

Coming back to the [health benefits of laughing](#), it has been shown to [reduce stress hormones](#) and [boost the immune system](#). [Laughing](#),

Medical uses of CNS acting chemicals include [analgesics](#), [antidepressants](#), [mood-stabilizers](#), and drugs for [delaying the onset of Alzheimer's disease](#). [Pain relieving drugs](#) are designed to alter the way that the brain identifies pain and signals pain response to other parts of the body. Given the broad spectrum of CNS related health conditions, research into new CNS acting drugs, [many based on natural products](#), is an active field. As with all medications, use comes with a risk of side effects, particularly when using [mixtures of CNS acting substances](#). As the sympathetic nervous system has overlap with the CNS, [anesthetics](#) can also affect the CNS (and many of these compounds are [inhalable](#)). Some CNS acting medicines are sold over the counter, these however, are far from the CNS acting chemicals that are raising non-proliferation concerns; for example, the [analgesic Ibuprofen](#) (with 1.98 billion USD in annual sales). [Ibuprofen](#) and other [analgesics](#) inhibit COX enzymes, preventing the formation of the pain and swelling inducing prostaglandins. CNS acting chemicals can also act as lead compounds for the [development of drugs to non-CNS targets](#). [Drugs of abuse](#) may also be CNS active chemicals, for example [stimulants](#), [opiates](#) and [hallucinogens](#).

The use of opiates, in particular [fentanyl](#) (which is [80 - 100 times more potent than morphine in oral doses](#)) and its [analogs carfentanil and remifentanil](#), are of interest in [non-proliferation communities](#) for their potential as incapacitating chemical agents; fentanyl itself has been [implicated in the death of singer Prince](#). These chemicals are known to [target opioid receptors](#). Given the [abuse potential for fentanyl](#) (along with other opiates), there is interest in medical countermeasures. For overdoses of opiates, [naloxone](#) can be used and [new methods for safe delivery](#) continue to be developed. A [fentanyl vaccine](#) tested in mice was also recently reported.

The prevalence of drugs of abuse has raised some unexpected environmental issues; commonly abused drugs have been detected in [tap water](#), [river basins](#), [sewers](#) and [waste-water treatment plants](#). Wastewater concentrations of drugs can actually be [correlated](#) with increased drug use within a given area and population.

In some cases, medications entering the environment can have significant impact on wildlife.



A white-rumped vulture (*Gyps bengalensis*), a species that has undergone population decline in some parts of the world, due to feeding on the carcasses of diclofenac treated cattle. Image courtesy of [Goran Ekstrom](#).

Take for example, the anti-inflammatory drug, [diclofenac](#). [This veterinary painkiller used to treat livestock in South Asia from the early 1990s until 2007](#), has been implicated in declines of more than 95% in vulture populations from feeding on carcasses of diclofenac-treated animals in [India](#) and [Pakistan](#) during that time period. Recent approval for use of the same drug in livestock in [Europe](#) has raised new concerns.

From disarmament to medicine to the environment, issues related to CNS acting chemicals span a broad range of sectors with potentially overlapping areas of interest.

Questions, ideas, comments, suggestions, want to make a contribution, or be added to the mailing list? Please contact us through [the OPCW Office of Strategy and Policy \(OSP\)](#).

For more frequent updates, Visit us on the [web](#) or follow us on Twitter at [@OPCW_ST](#).



[or a lack thereof, can affect your heart](#), with heart disease sufferers laughing 40% less and being less likely to recognise humour than people without heart disease of the same age. So if you have been described as ‘miserable’ or ‘unable to take a joke’, it may be time to cut down on the stress and pop in to the doctor. Just in case!

Upcoming S&T Related Events

[OPCW Calendar of Events October to December 2015](#)

6 - 7 July 2016

[Border Sessions – International Festival on Technology and Society](#)

The Hague, Netherlands

11 – 16 July 2016

[AAAS-TWAS Course on Science Diplomacy 2016](#)

Trieste, Italy

13 July 2016

[“Science for Diplomats” at EC-82.](#)

“Isotopic labels, stereoisomers and scheduled chemicals, why does this matter? A Review of the Scientific Advisory Boards Advice”

OPCW Headquarters, The Hague, Netherlands



18 – 22 July 2016

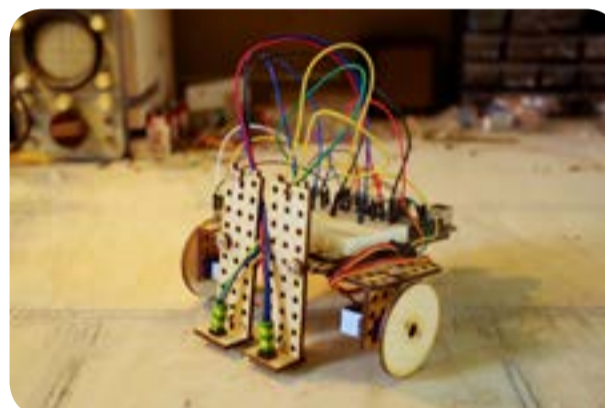
[The International Conference on Pure and Applied Chemistry \(ICPAC 2016\)](#)

“Emerging Trends in Chemical Sciences”

Mauritius

Artificial Intelligence

“[Deep learning](#)”, “[fuzzy logic](#)”, [[artificial](#)] “[neural networks](#)”, “[support vector machines](#)”, “[genetic algorithms](#)” and “[existential threat](#)”, are just a few of the terms we hear in relation to [artificial intelligence \(AI\)](#). AI holds fascination for [what it may enable](#), all the while evoking [fears of self-aware robots](#) set to enslave humanity (after which they might want to try to become [biological](#)) and perhaps an [AI arms race](#). Take a look behind the jargon and the hype, and you will find computational algorithms that [allow machines to make decisions and solve problems](#) on their own – in an intelligent way. Intelligence often achieved through [machine learning](#), a technique that enables decision-making and prediction on the basis of previous data.



Top: Kismet, a robot head used at MIT in the 1990s to simulate emotions.

Bottom Left: Industrial robot at the Oregon Museum of Science and Industry. Bottom Right: A [DIY robot](#) for educational purposes.

Images courtesy of [Chris Devers](#), [Peat Bakke](#) and [Maciej Wojnicki](#).

to adapt in real time under dynamic circumstances ([trial and error learning](#)), or even run a [simulation to determine how to best adapt to a situation](#), could benefit emergency response ([robots used in the aftermath of the Fukushima incident](#), for example). The use of AI for [information analysis in disaster response](#) is likewise, an active area of research (“[Digital Response](#)”).

How are intelligent robots (and AI machines in general) trained? Virtual environments (e.g. video games such as [Minecraft](#)), [behavioral psychology](#) (details [here](#)) and [robots teaching robots](#) represent some of the approaches being explored. Human intervention is also helpful (for example in [teaching AI how to count moving wildlife](#) from drone-collected footage). As for AI playing games, well, they just [keep getting better](#) at winning (even against [fighter pilots](#))!

While AI is often associated with robots, it actually finds much broader applications (in the [sciences](#) and beyond). We are already seeing AI applications in [biomedical](#) research and [medicine](#) (yes, there are [apps to help medical doctors make decisions](#) and AI that can [help diagnose cancer](#)). Other medical applications include recognizing signatures of diseases such as [diabetic retinopathy](#) or diagnosing [malaria in blood samples](#) (by recognizing patterns in pictures); as well as AI [biomarker detection by electronic noses](#), analysis of [mass spectral data from blood samples](#) for cancer detection, and [classifying the tissue origin of tumors](#). In broader life science research, the data is so immense (just look at the [genomes portion](#) of it) and complex that some say [AI is necessary to help decipher it](#)! AI is of course already finding application in fields such as [proteomics](#).

In chemistry, applications include drug discovery (using [neural networks](#) and [machine learning](#)), [toxicity screening](#), studying [structure-activity relationships](#), [identifying components of mixtures](#), as [estimators in chemical process systems](#), processing chemical information coming from [sensor arrays](#) and [electronic noses](#), [waste water treatment](#) and the [mining of lab notebooks](#) to

The field has certainly advanced far beyond the first seemingly intelligent chatbots, like [ELIZA](#) (“who” you can still [speak](#) with). Yet at the time, some actually mistook her for a human (and she did pass a restricted [Turing Test](#), a test that is intended to determine whether a machine can think). Today, there are still questions about what might be missing in AI, perhaps “[general intelligence](#)”, or the ability to [derive meaning](#)? Will this always be the case? Keep in mind that the

[machines themselves seem to be learning more and more](#) every year and there is greater [investment than ever before](#) (and at least one robot was named to the [board of directors of a V.C Firm](#)).

One key enabler for intelligent machines is to teach them [to function outside of their programming](#). The ability

1 – 31 August 2016

[Virtual Conference on Computational Science \(VCCS-2016\)](#)

15 – 19 August 2016

[Big Data for Peace and Justice Summer School](#)

The Hague, Netherlands

15 – 20 August 2016

[24th IUPAC International Conference on Chemistry Education \(ICCE 2016\)](#)

Kuching, Sarawak, Malaysia.

21 - 25 August 2016

[252nd American Chemical Society National Meeting & Exposition](#)

Philadelphia, PA

United States of America

4 – 7 September 2016

[52nd Congress of the European Societies of Toxicology \(EUROTOX2016\)](#)

Istanbul, Turkey

4 – 8 September 2016

[6th International IUPAC Conference on Green Chemistry](#)

Venice, Italy

4 – 9 September 2016

[Asser Institute Summer Programme on Disarmament and Non-Proliferation of Weapons of Mass Destruction in a Changing World](#)

The Hague, The Netherlands

6 – 8 September

[Spiez CONVERGENCE](#)

Spiez, Switzerland

11 - 15 September 2016

[6th EuCheMS Congress](#)

Seville, Spain

12 September 2016

[TOXI-Triage Workshop/Master Class on Operational Specifications for CBRN Crisis Management](#)

Helsinki, Finland

26 – 27 September

[OPCW Scientific Advisory Board workshop on chemical warfare agent toxicity, emergency response and medical countermeasures](#)

Paris, France

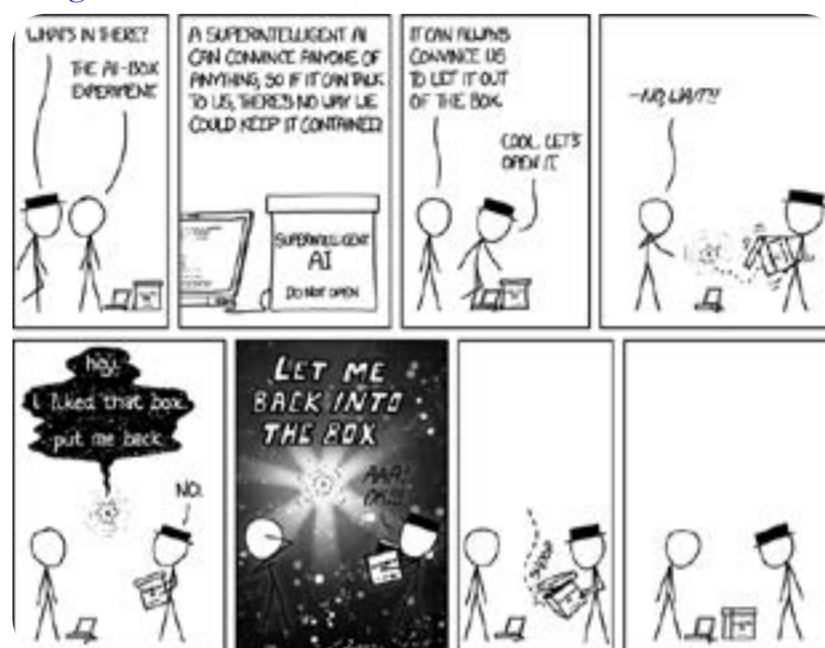
29 – 30 September 2016

[Science and Policy-Making: towards a new dialogue](#)

Brussels, Belgium

gain insight from failed experiments. There have been reports of AI used to [detect nerve agent simulants with sensor arrays](#), [identify organic explosive residues](#) and neural networks that can [recognize chemical warfare agents](#). Of further relevance to chemical warfare agents, [AI has been used to predict acetylcholinesterase inhibition](#).

As new developments in AI continue to emerge, we are sure to see further concerns on [safety](#) and security [issues](#) and discussions on how AI [affects society](#). Scientists are already developing techniques to [prevent an AI from learning what it should not](#), as well as how to [counter](#) attacks on AI systems. On the positive side, there are projects to develop and promote humanity-friendly [open source AI software](#) (and [search engines](#)), as well as efforts to protect privacy (for example restrictions on [image-recognition on phones](#)). Perhaps we need to [teach the machines to understand us](#)? With all the attention AI is getting, is it being [oversold](#)? Independent of the answer, [AI is becoming mainstream!](#)



"AI-Box Experiment" by xkcd.

Reports from Sessions of the OPCW Scientific Advisory Board, and Advisory Board on Education and Outreach; and OPCW Day

April and May 2016 were busy months at OPCW, with sessions of the Scientific Advisory Board and the Advisory Board on Education and Outreach; and the celebration of OPCW's foundation at OPCW Day.

The [OPCW Scientific Advisory Board \(SAB\)](#) held its [Twenty-Third Session](#) from 18 to 22 April 2016, under the chairmanship of Dr Christopher Timperley, with Mr Chen Tang serving as Vice-chair. During the session the SAB was briefed on the follow up activities from its recommendations from the temporary working groups on [Verification](#) and [Convergence](#), and from the [Third Review Conference](#); the Board's Advice on [isotopic labels and stereoisomers of scheduled chemicals](#); and, [stability and storage of chemical weapons related samples](#) was issued in reports; and preparations for the report on developments in science and technology to the Fourth Review Conference were discussed; and States Parties [received a briefing](#).

The SAB will meet again for its Twenty-Fourth Session from 25-28 October. It also held the first of its [workshops to prepare its report to the Fourth Review Conference, on chemical forensics](#), from 20-22 June in Helsinki (a report is forthcoming). For further information see the report of the [Twenty-Third Session](#) and the [response from the Director-General](#).



3 – 5 October

The 2nd International Symposium on Applied Chemistry (ISAC) 2016: [Chemistry for Better Life](#)
BSD City, Indonesia

12 October 2016

[“Science for Diplomats”](#)
at [EC-83](#).

Report on Scientific Advisory Board’s workshop: Chemical Forensics: Capabilities across the Field and the Potential Applications in Chemical Weapons Convention Implementation
OPCW Headquarters, The Hague, Netherlands

14 October 2016

[Sensor Day 2016](#)

A showcase of international sensor research
University of Cambridge, United Kingdom

18 – 20 October 2016

[Regional Workshop on Policy and Diplomacy for Scientists: Introduction to Responsible Research Practices in Chemical and Biological Sciences](#)
Pretoria, South Africa

25 - 28 October 2016

24th Session of OPCW Scientific Advisory Board
OPCW Headquarters
The Hague, The Netherlands

7 - 25 November 2016

[BWC Eighth Review Conference](#)
Geneva, Switzerland

6 - 8 December 2016

[CHAINS 2016, the Dutch chemistry conference](#)
Veldhoven, The Netherlands

The [OPCW Advisory Board on Education and Outreach](#) (ABEO) held its [inaugural Session from 28 – 29 April 2016](#), under the chairmanship of Dr Jean Pascal Zanders, with Dr Edith Valles serving as Vice-chair. This Advisory Board will provide [specialised advice in areas of education and outreach relevant to Chemical Weapons Convention](#) to the Director-General. In his [opening statement](#), Director-General Ahmet Üzümcü stressed that “...the creation of this Board signifies the growing importance of education and outreach to the life of the Organisation”. The Board will meet again from 5-6 October to continue the work initiated at this inaugural session. Further information is available in the [report of the ABEO’s First Session](#). The [ABEO Chair](#) also [held a briefing for participants of the OPCW Day event](#).



Participants at the First Session of the Advisory Board on Education and Outreach with the Director-General.

[OPCW Day](#), an event celebrating the foundation day of the OPCW, was held from 2 – 4 May. This inaugural OPCW Day Conference was held under the theme *Chemical Safety and Security in a Technologically Evolving World*. This theme reflecting change and the need to be future focused as we celebrate past accomplishments, with the OPCW being in a position to enhance global security by promoting peaceful uses of chemistry and engaging international partners to assess and combat current and future threats. This event brought together stakeholders from across relevant communities in disarmament, and chemical and technology industries to discuss innovation and a world free of chemical weapons. The [programme](#) included panel discussions, interactive workshops, a [poster session](#) and an exhibition.

The conference opened with [remarks](#) from the OPCW Director-General, the [Secretary-General of the Ministry of Foreign Affairs of the Netherlands](#), the [Mayor of The Hague](#), the [Chairperson of the Conference of States Parties](#), the [Vice-Minister of the Ministry of Foreign Relations and Worship of the Argentine Republic](#), a statement from [the United Nations Secretary-General](#); and keynote addresses from the [Executive-Secretary of the Comprehensive Nuclear Test Ban Treaty Organisation](#), the [Chief Scientific Adviser to the Ministry of Defence of the United Kingdom of Great Britain and Northern Ireland](#), and chemistry Nobel Laureate [Professor Martin Karplus](#).



Left: OPCW Spokesperson and Head of Public Affairs, Deepti Choubey, with the participants shouting “Chemistry!”
Top: OPCW Day Participants during the OPCW Laboratory Tour.
Images © OPCW.

Three parallel tracks of panel discussions covered thematic topics: Chemical Safety and Security, Future Scenarios, and Technology Foresight.

The Chemical Safety and Security Track included panels on current practices and challenges (with presentations from [OPCW](#), the [Foreign Policy Directorate of the Spanish Ministry of Foreign Affairs](#), the [Institute of Scientific and Technological Research for Defense of Argentina](#), and the Hague Security Delta); opportunities and threats (with presentations from [current](#)

Crowdsourcing

Science communication without PowerPoint or speaking: can you "[Dance your Ph.D.](#)"? Not a dancer? Perhaps you have a [favorite science moment captured by a photo or video](#)?

The IAEA is looking to improve the capabilities of an instrument routinely used by inspectors to verify declarations related to spent fuel assemblies stored in cooling pools. [Are you up to the challenge?](#)

Can [research be improved through video games](#)? Take a look at [massively multiplayer online science](#), a platform that connects scientific research and video games.

For non-video game based crowdsourcing, [a recent report reviews factors that influence success](#).

The links to articles, papers, reports, websites or other materials incorporated herein are being provided for information purposes only. The views and opinions expressed in the aforementioned materials are those of the authors and do not necessarily reflect the views of the OPCW. These items are cited as a service to readers and do not imply endorsement by the OPCW. The OPCW does not provide any guarantee, express or implied, that the information presented is accurate or timely, and does not contain inadvertent technical or factual inaccuracies. The OPCW is not responsible for the content of third party websites.

and [former](#) Ambassadors to the OPCW, [UNICRI](#), and [WHO](#)); industry perspectives (with presentations from [ICCE](#), [ICC](#), [Nicia Mourão](#), and [OPCW's Industry Verification Branch](#)); and, an International Organisation perspective (with presentations from [UNEP](#), [WCO](#), and [UNECE](#)).

The Future Scenarios Track included panels on the globalised world (with presentations from [economic](#), [industrial](#) and [scientific perspectives](#)); the world in 2050 (with presentations from [OPCW](#), [Professor Alastair Hay](#), [LanzaTech](#) and [Dr Ivo Šlaus](#)); the future of the CWC (with presentations from [Dr Jean Pascal Zanders](#), [Dr Rolf Ekéus](#), [Dr Saad Abdulmajeed Ibrahim Al Ali](#), and [a former Head of the OPCW Chemical Demilitarisation Branch](#)); and, a look at regulation and the pace of change (with presentations from an OPCW [legal officer](#) and the [Legal Adviser](#), [H.E. Santiago Oñate](#), and [Professor Tetsuya Abe](#)).

The Technology Foresight Track included panels on the current capabilities and future needs (with presentations from [Spiez Laboratory](#), [OPCW Office of Strategy and Policy](#), [Declarations Assessment Team](#), and the [OPCW SAB Chair](#)); technology development in the Designated Laboratories (with presentations from the [OPCW Lab](#), [TNO](#), [FOI](#) and [AMMSLTA](#)); emerging technologies (with presentations from the [OPCW SAB Vice-chair](#), the [BWC ISU](#), the IAEA and [The Centre for Innovation at Leiden University](#)); and, future technologies (with presentations from ESA, [Comon Invent](#) and [CEA](#)).

OPCW Day concluded with keynote presentations from the [European Space Agency](#), [Professor Alastair Hay](#), [Dr Ivo Šlaus](#) and [BASE](#); and a [closing statement from the OPCW Director-General](#).

Other meetings with science relevance held in April and May at OPCW included an [Experts Group Meeting on Green Chemistry](#) and a [Symposium on Women in Chemistry](#), both organised by OPCW's International Cooperation Branch.

Machine-learning algorithms can predict the toxicity of sulfur mustard breakdown products?

Did You Know?



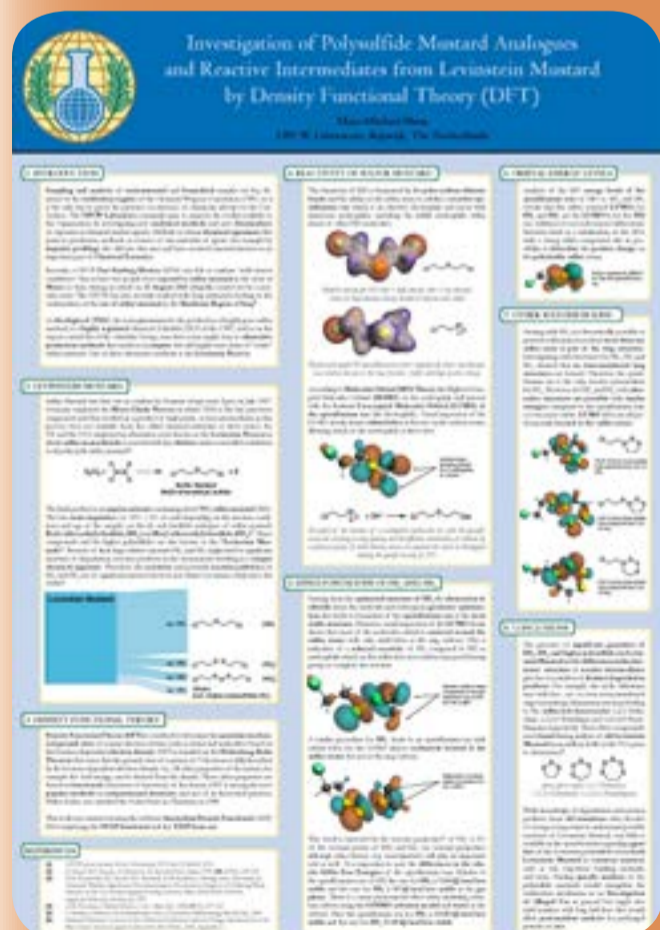
Winners of the Poster Session at OPCW Day



[Chemical Safety and Security in Kenya](#) by Austin Ochieng and the [Kenya Chemical Society](#).



[Responsible Science: A Vehicle for Sustainable Chemical Safety and Security Implementation in Iraq](#) by Kabrena Rodda and Jessica Gray.



[Investigation of Polysulfide Mustard Analogues and Reactive Intermediates from Levinstein Mustard by DFT](#) by Marc Blum.

The solution to last issue's Puzzle!



Fool's Gold (Au)



Carbon (C) Freeze



Platinum (Pt) Credit Card



Iron (Fe) Curtain



Helium (He) Balloon



Tin (Sn) Man



Silicon (Si) Valley



Enriched Uranium (U)



Rock Salt (NaCl)



Tungsten (W) Filament



Silver (Ag) Bullet



Copper (Cu) Penny/Coin



Sulfur (S) Mustard



Lithium (Li) Battery



Hydrogen (H) Bomb