

Trends in Chemical Production

Science for Diplomats at CSP-22

The Report of the Scientific Advisory Board's Workshop

Join us for an afternoon of hands-on chemical synthesis.



Wednesday, 29 November 2017

Antarctica Room, World Forum

13:15-14:45

Light lunch served at 13:00

November 2018: A Time to Review



Third Special Session of the
Conference of the States
Parties to Review the
Operation of the Chemical
Weapons Convention

8-19 April 2013

Organisation for the Prohibition of Chemical Weapons

November 2018: A Time to Review

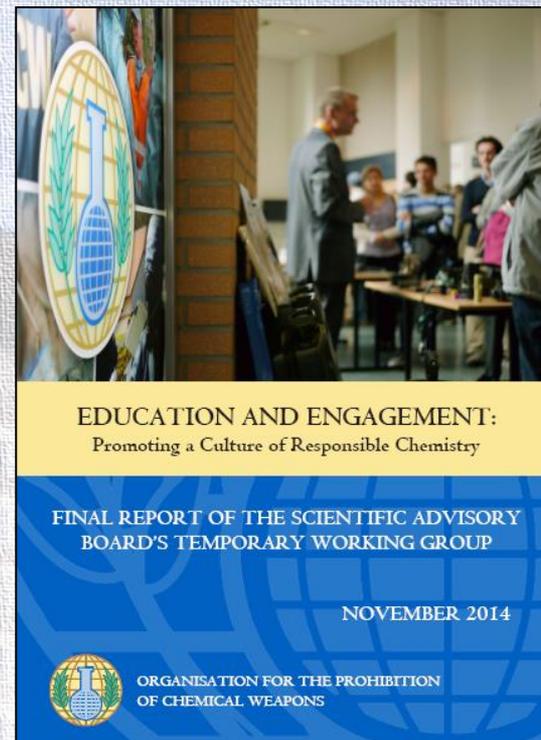
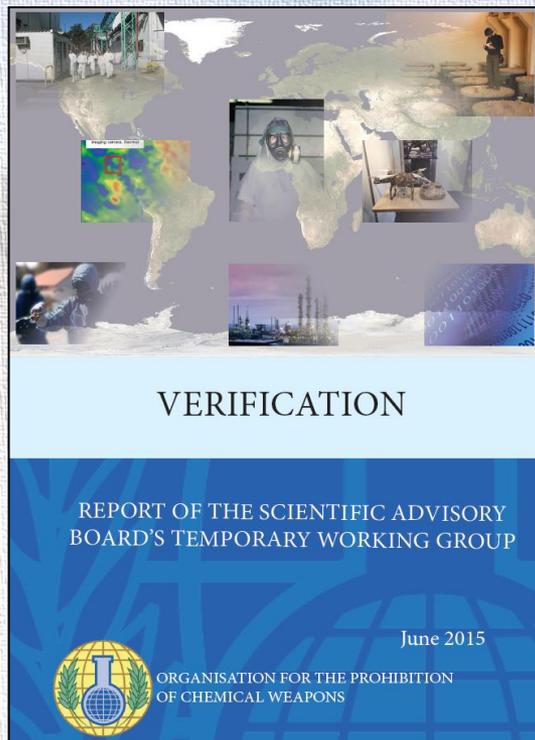
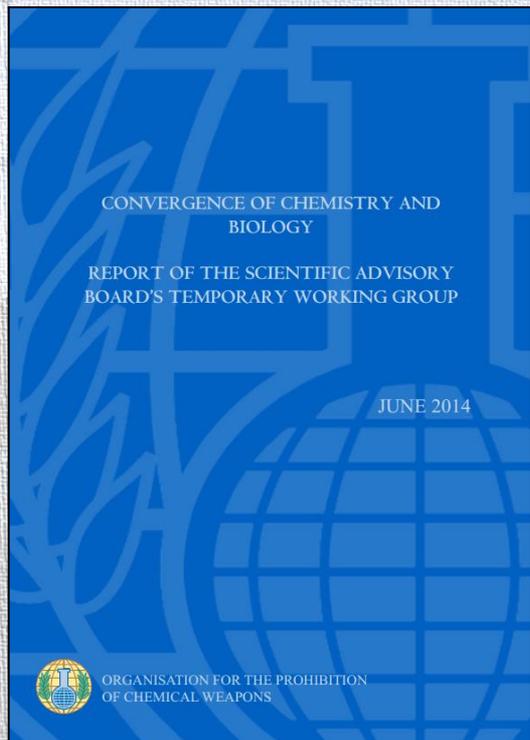
Third Special Session of the
Conference of the States
Parties to Review the
Operation of the Chemical
Weapons Convention

8 - 19 April 2013

Organisation for the Prohibition of Chemical Weapons

SAB Report:
Overview of scientific and technological changes during review period
Advice on relevant and emerging areas of science and technology
Recommendations for moving forward

The Scientific Review



The Scientific Review

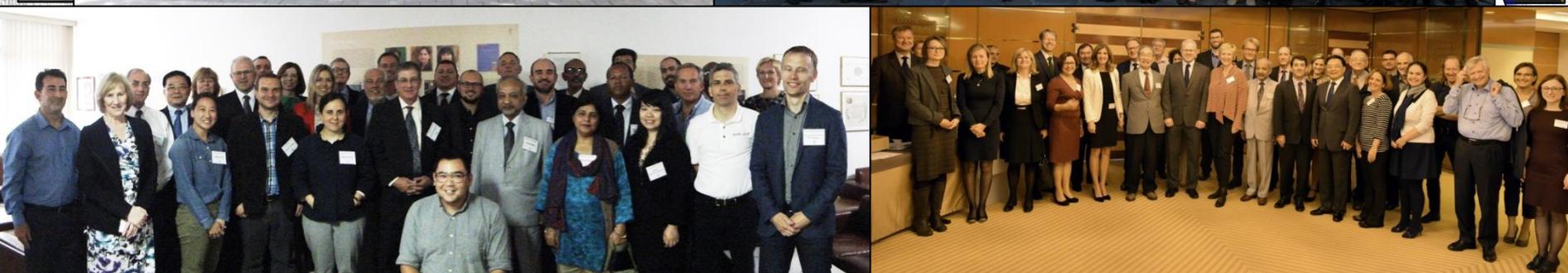


The Scientific Review

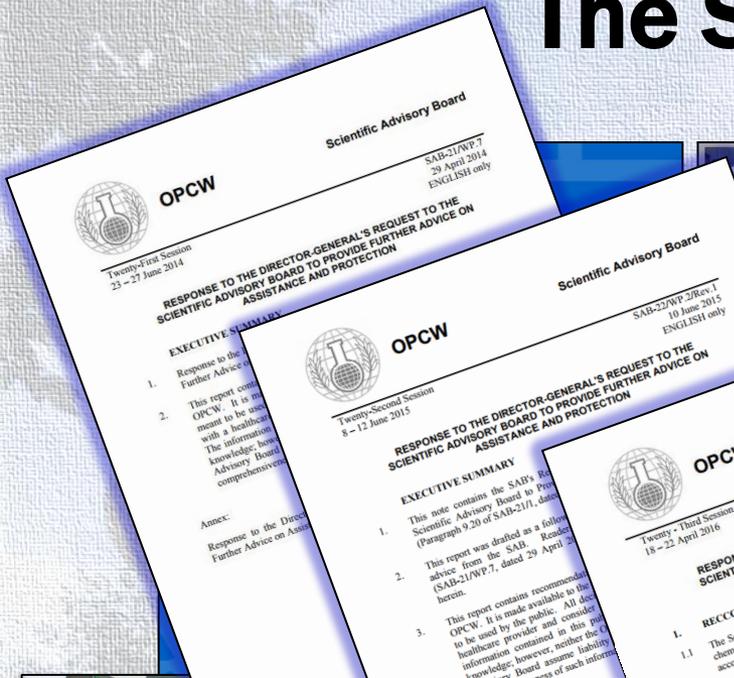
This section features a collage of five OPCW Scientific Advisory Board report covers and several photographs of the board's activities. The reports are:

- Report 1:** SAB-21/WP.7, 29 April 2014, ENGLISH only. Title: **RESPONSE TO THE DIRECTOR-GENERAL'S REQUEST TO THE SCIENTIFIC ADVISORY BOARD TO PROVIDE FURTHER ADVICE ON ASSISTANCE AND PROTECTION**. Twenty-First Session, 23-27 June 2014.
- Report 2:** SAB-22/WP.1, 10 June 2015, ENGLISH only. Title: **RESPONSE TO THE DIRECTOR-GENERAL'S REQUEST TO THE SCIENTIFIC ADVISORY BOARD TO PROVIDE FURTHER ADVICE ON ASSISTANCE AND PROTECTION**. Twenty-Second Session, 8-12 June 2015.
- Report 3:** SAB-23/WP.1, 28 April 2016, ENGLISH only. Title: **RESPONSE TO THE DIRECTOR-GENERAL'S REQUEST TO THE SCIENTIFIC ADVISORY BOARD TO PROVIDE FURTHER ADVICE ON SCHEDULED CHEMICALS**. Twenty-Third Session, 18-22 April 2016.
- Report 4:** SAB-23/WP.2, 25 May 2016, ENGLISH only. Title: **RESPONSE TO THE DIRECTOR-GENERAL'S REQUEST TO THE SCIENTIFIC ADVISORY BOARD TO PROVIDE FURTHER ADVICE ON STABILITY AND STORAGE**. Twenty-Third Session, 18-22 April 2016.
- Report 5:** SAB-25/WP.1, 8 April 2017. Title: **RESPONSE TO THE DIRECTOR-GENERAL'S REQUEST TO THE SCIENTIFIC ADVISORY BOARD TO PROVIDE FURTHER ADVICE ON STABILITY AND STORAGE**. Twenty-Fifth Session, 1-5 April 2017.

The photographs show the board members in various settings: a meeting room with a world map, a group photo in front of the OPCW flags, and a group of people in a conference room.



The Scientific Review



25 Events

676 Attendees

- 256 individuals

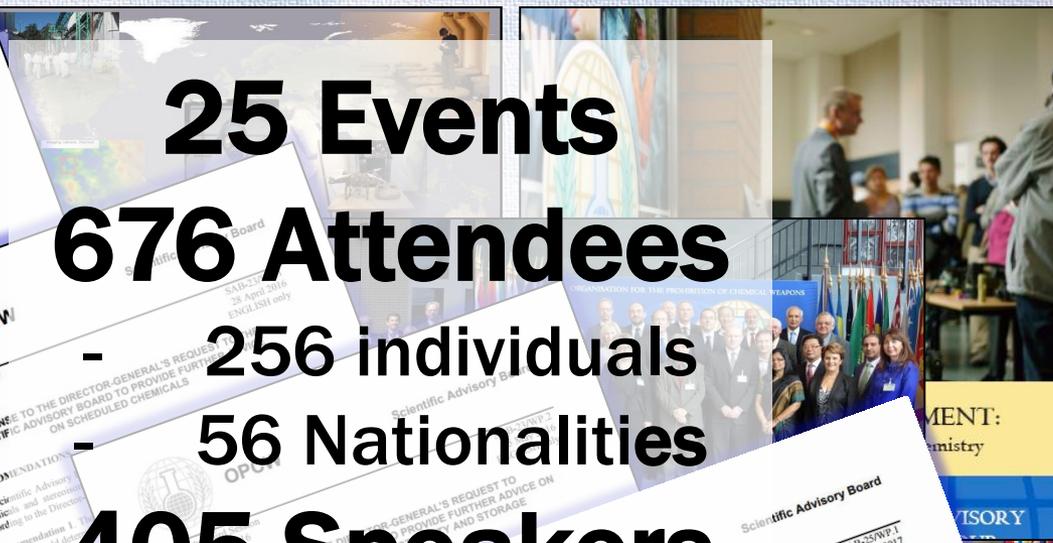
- 56 Nationalities

405 Speakers

- 191 individuals

- 56 Nationalities

30 Reports



The Lead Up To Previous Review Conferences

Pure Appl. Chem., Vol. 74, No. 12, pp. 2323-2352, 2002.
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INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

IMPACT OF SCIENTIFIC DEVELOPMENTS ON THE CHEMICAL WEAPONS CONVENTION (IUPAC Technical Report)

Prepared for publication by
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Pure Appl. Chem., Vol. 80, No. 1, pp. 175-200, 2008.
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IMPACT OF SCIENTIFIC DEVELOPMENTS ON THE CHEMICAL WEAPONS CONVENTION (IUPAC Technical Report)

Prepared for publication by
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Pure Appl. Chem., Vol. 85, No. 4, pp. 851-881, 2013.
http://dx.doi.org/10.1351/PAC-REP-12-11-18
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Impact of scientific developments on the Chemical Weapons Convention (IUPAC Technical Report)*

Katie Smallwood¹, Ralf Trapp², Robert Mathews³, Beat Schmidt⁴, and Leiv K. Sydnès^{5,1}

¹Independent Consultant, Geneva, Switzerland; ²International Disarmament Consultant, 74270 Chessenaz, France; ³Defence Science and Technology Organisation, Australia; ⁴Spiez Laboratory, 3700 Spiez, Switzerland; ⁵Department of Chemistry, University of Bergen, 5007 Bergen, Norway

Abstract: This document represents the final report of discussions and conclusions arising from the workshop on Developments in Science and Technology Relevant to the Chemical Weapons Convention, held in Spiez, Switzerland in February 2012.

Keywords: Chemical Weapons Convention; CWC; implementation; science and technology; Third Review Conference.

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 - 3.8 Chemical safety and security: Engaging the chemical sciences community
 - 3.9

*Sponsoring body: IUPAC Executive Committee; see more details on p. 876.
*Corresponding author: Email: kati.smallwood@kj.ahj.se

International Advisory Board: IUPAC Workshop, Bergen, 2012
(UK): Watan Ando (Japan); Joseph F. Burnett (USA); Will Chen (China); Rina Crocels (Belgium); Claude Eon (France);
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175



International Workshops of the OPCW Scientific Advisory Board

A European Union Funded Project

In Support of Scientific Review for the Fourth Review Conference of the Chemical Weapon Convention

4 Workshops with a total attendance of **187**

159 Individuals from **40** States Parties

111 Presentations from **91** Individual Presenters



OPCW
Organisation for
the Prohibition of
Chemical Weapons

1997-2017



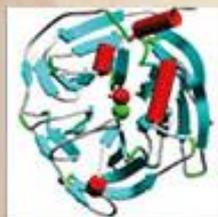


Chemical Forensics: Capabilities across the Field and the Potential Applications in Chemical Weapons Convention Implementation

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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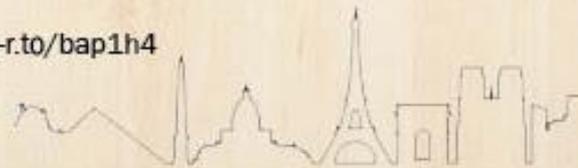


Chemical Warfare Agents: Toxicity, Emergency Response and Medical Countermeasures

Paris, France. 26 to 27 September 2016

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

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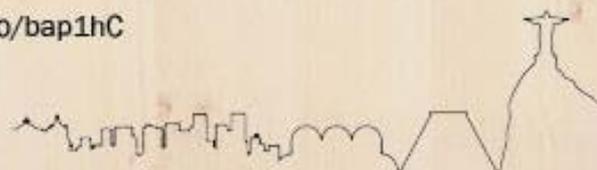
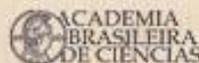


Innovative Technologies for Chemical Security

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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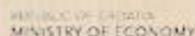


International Workshop on Trends in Chemical Production

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:





Spiez Laboratory & OPCW Present Science for Diplomats at CSP-21

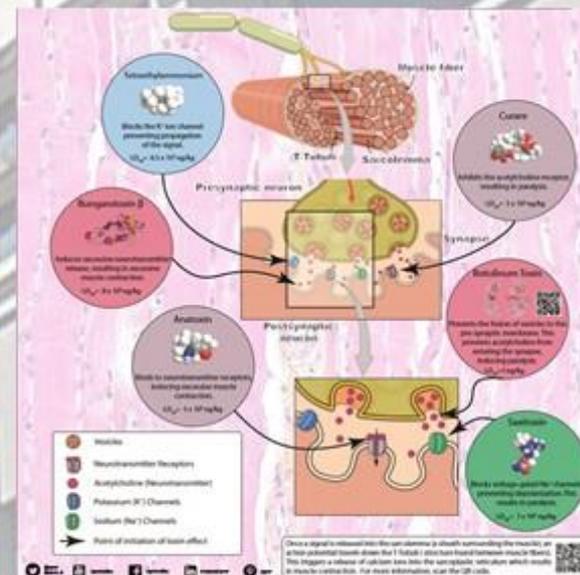


Wednesday 30 November 2016 Europe Room, World Forum 13:00 – 15:00

A Review of three workshops: Spiez CONVERGENCE 2, and the OPCW SAB's Chemical Forensics and Toxicity of Chemical Agents; with lunch



Background image courtesy of TNS Sofres
www.flickr.com/photos/124561666@N02/



Science for Diplomats at EC-86

Innovation

and

the **C**hemical **W**eapons **C**onvention:

The **S**cientific **A**dvisory **B**oard's Report on
Emerging Technologies



Tuesday, 10 October 2017

Ooms Room 13:30-14:45

Light Lunch Available At 13:00



OPCW

1997-**20**17
YEARS





Institute for Medical
Research and
Occupational
Health



1923 Chemical & Engineering News begins as the **News Edition of Industrial & Engineering Chemistry**.

▲ 1923 Acids and bases get refined definitions—one from Johannes N. Brønsted and Thomas M. Lowry, another from Gilbert N. Lewis.

▲ **1923** Fitzhugh Reed, an anti-knock additive to gasoline, earns its discoverer, Thomas Midgley Jr., an ACS award.

1925 Six German firms merge to form the IG Farben conglomerate. It soon becomes the world's biggest chemical company.

1925–27 Work from Werner Heisenberg, Wolfgang E. Pauli, and Erwin Schrödinger ushers in the era of quantum mechanics.

1926 Four U.K. chemical companies merge to form Imperial Chemical Industries (ICI). In its heyday it will become the British Empire's largest manufacturing firm.

1930s Sulfonamides (sulfa drugs) are introduced. They are the first antibiotics commercialized.

1932 Harold C. Urey discovers deuterium.

1932 James Chadwick discovers the neutron.

1932 Albert Szent-Györgyi and Charles G. King independently isolate vitamin C.

▲ 1935 DuPont chemists Wallace H. Carothers (pictured) and Gerard Berchert invent nylon.

1935 ICI patents the process for polyethylene, one of today's most common plastics.

1937 Eugene J. Houdry develops industrial-scale catalytic petroleum cracking, setting the stage for the modern oil refinery.

► **1941** To show that his chlorofluorocarbon (CFC) coolant, Freon, is nontoxic and nonflammable, Thomas Midgley Jr. takes the stage at an ACS national meeting, inhales a lungful of Freon, and blows out a candle.

1941 Archer J. P. Martin and Richard L. M. Synge begin publishing that would lead to partition chromatography, revolutionizing analytical chemistry.

1942 ACS renames its flagship magazine **Chemical & Engineering News**.

1942 Mustard gas, 1,1'-thiobis(2-chloroethane), a chemical weapon in World War I, becomes the first compound used in chemotherapy for treating cancer.

1943 Experimenting on himself, Albert Hofmann experiences the world's first lysergic acid diethylamide (LSD) trip.

1944 Selman Waksman isolates the antibiotic streptomycin, the first effective treatment for tuberculosis.

1945 The U.S. explodes first atomic weapon at Alamogordo, N.M., and drops two bombs over Japan to end World War II.

1953 Stanley L. Miller and Harold C. Urey make a splash in origin-of-life research, forming amino acids from gases that the believed mimicked early Earth's atmosphere.

1955 Frederick Sanger determines the first complete amino acid sequence of a protein, insulin.

1955 Melvin E. Calvin traces the complete path that carbon takes in a plant during photosynthesis.

► **1955** Procter & Gamble scientists develop the first fluoride-containing toothpaste shown to prevent cavities.

1957 Resphenol A is first used commercially to make plastics and epoxy resins.

► **1958** Mass spectrometry is used to analyze amino acids and peptides for the first time.

1962 Neil Bartlett proves that noble gases can form chemical compounds by preparing XePtF₆.

► **1962** Rachel Carson's book "Silent Spring" alerts the public to environmental damage from industrial chemicals, including DDT.

1962 The Quantum Chemistry Program Exchange (QCPE) begins. It provides an inexpensive way for theoretical chemists and other scientists to exchange software.

1963 Hoffmann-La Roche launches the sedative Valium (diazepam).

1964 First commercial quadrupole mass spectrometer debuts.

1964 Chemical Abstracts Service introduces the CAS Registry, the first computer-based system for storing chemical representations.

1970 Robert Burns Woodward (pictured) and Albert Eschenmayer report the first total synthesis of vitamin B-12.

1973 Paul C. Lauterbur describes the medical imaging technique MRI (magnetic resonance imaging).

1974 Mario J. Molina and F. Sherwood Rowland publish their theory that CFCs lead to atmospheric ozone depletion.

1975 César Milstein and Georges Köhler devise a strategy for producing monoclonal antibodies.

1976 Herbert W. Boyer and Robert A. Swanson set up Genentech, the first biotechnology company.

1976 Congress passes the Toxic Substances Control Act to regulate the chemicals in everyday products.

1980 In large part because of Love Canal, Congress passes the Comprehensive Environmental Response, Compensation & Liability Act (Superfund).

► **1981** IBM Zurich's Gerd Binnig and Heinrich Rohrer develop scanning tunneling microscopy, which Donald M. Eigler later uses to manipulate individual atoms.

1983 Sidney Altman and Thomas R. Cech independently show that RNA can be a catalyst.

1984 A methyl isocyanate leak at a Union Carbide plant in Bhopal, India, kills thousands.

► **1985** A hole in Earth's atmospheric ozone layer is first observed over Antarctica.

1987 The Montreal Protocol, an international treaty designed to protect the ozone layer.

1987 FDA approves azidothymidine (AZT) to treat HIV/AIDS.

1988 Inter-governmental Panel on Climate Change is established.

1986 The Chernobyl nuclear power plant in the Soviet Union has a reactor core meltdown, releasing massive amounts of radiation.

1986 Congress creates the Toxic Release Inventory of hundreds of chemicals released into air, water, or land.

1986 Cambridge Scientific Co. debuts the ChemDraw structure-drawing program for computers.

► **1986** Johannes G. Bednorz and Karl A. Müller discover the first high-temperature superconductor.

1987 Eli Lilly & Co. receives approval to market Prozac (fluoxetine) to treat depression.

1987 Nations begin signing the Montreal protocol, an international treaty designed to protect the ozone layer.

1987 FDA approves azidothymidine (AZT) to treat HIV/AIDS.

1988 Inter-governmental Panel on Climate Change is established.

► **1992** Robert A. Holton patents a route to Taxol that begins with a compound in yew tree needles, sparing the trees.

1993 Dow Chemical wins Supreme Court decision in the Daubert case, requiring judges to use peer-reviewed science in court.

1994 Calgene's Flavr Savr tomato becomes the first genetically modified food to hit the market.

1995 Eric A. Cornell and Carl E. Wieman make the first Bose-Einstein condensate, which displays quantum mechanical properties on the macroscopic scale.

1996 The Food Quality Protection Act and amendments to the Safe Drinking Water Act require EPA to develop a program to screen chemicals for their potential to interact with the human endocrine system.

1996 EPA finalizes the U.S. phaseout of leaded gasoline.

1996 Dolly, a sheep, is the first cloned animal.

1996 EPA finalizes the U.S. phaseout of leaded gasoline.

1997 Low doses of bisphenol A are found to have endocrine-disrupting effects in laboratory animals. Controversy begins over safety of bisphenol A in plastics.

1998 ACS Online debuts.

► **1998** FDA approves use of Viagra (sildenafil) to treat impotence.

1998 Z. Fire and Craig C. Mello demonstrate that small RNA molecules can inhibit gene expression in the worm *C. elegans*.

1998 Paul Anastas and John C. Warner publish the 12 Principles of Green Chemistry.

2000 Three independent research groups determine atomic resolution structures of the ribosome.

2001 Human Genome Project and Celera Genomics independently publish papers reporting the complete sequencing of the human genome. Pictured are J. Craig Venter (left) and Francis S. Collins.

2001 FDA approves Gleevec (imatinib) for treating leukemia caused by a specific gene defect.

2001 The pharmaceutical company Celera announces that it will supply AIDS drugs to Africa for a small fraction of market prices.

2002 FDA approves Humira (adalimumab), the first fully human monoclonal antibody drug, for the treatment of rheumatoid arthritis.

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2000 Masashi Miyano, Krzysztof Palczewski, and Ronald E. Stenkamp get first glimpse of a G protein-coupled receptor: a class of membrane proteins that are the targets of as many as 30% of marketed drugs.

► **2000s** Hydraulic fracturing (fracking) leads to a boom in U.S. natural gas production.

2004 The cholesterol-managing drug Lipitor (atorvastatin) becomes the first drug to top \$10 billion in annual sales.

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2004 Andre Geim and Konstantin Novoselov isolate individual sheets of graphene, sparking interest in the 2-D material's superlative properties.

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90 C&EN CELEBRATES 90 YEARS OF

Stronger bonds.

► **1928–29** Examining mold, Alexander Fleming discovers penicillin.

1937 Technetium is discovered. It's the first element to be artificially produced.

1938 Mass poisonings from an improperly prepared sulfa drug prompt passage of the Food, Drug & Cosmetic Act, which requires companies to perform safety tests.

► **1938** DuPont's Roy J. Plunkett accidentally discovers Teflon after having trouble with a gas cylinder.

1939 Linus C. Pauling publishes "The Nature of the Chemical Bond." The text becomes an instant classic.

► **1939** Paul Hermann Müller discovers that dichlorodiphenyltrichloroethane (DDT) is an effective insecticide.

► **1953** James D. Watson and Francis H. C. Crick determine DNA's double-helix structure.

1958 The first high-resolution protein structure debuts: John C. Kendrew and Max F. Perutz determine myoglobin's structure with X-ray crystallography.

1960 The birth control pill is approved for use in the U.S. Carl Djerassi and Alejandro Zaffaroni developed it in the 1950s from yam extracts in a lab in Mexico.

1965 Robert Burns Woodward and Rolf Hoffmann pull forth the Woodward-Hoffmann rules to explain stereochemistry in chemical reactions.

1965 DuPont chemist Stephanie L. Kwolek invents the strong but light polymer Kevlar.

1966 Weston A. Anderson and Richard R. Ernst develop Fourier transform NMR, laying the groundwork for modern NMR spectroscopy.

1967 Monroe E. Wall and Mansukh C. Wani isolate the future cancer drug, Taxol (paclitaxel) from the bark of the Pacific yew tree.

1968 George C. Cotzias shows that the psychoactive drug levodopa is effective against symptoms of Parkinson's disease.

► **1970** President Richard Nixon's executive order launches the Environmental Protection Agency.

1970 Congress passes the Clean Air Act, the first of many environmental regulatory laws in the 1970s.

1972 Paul Berg performs the first successful recombinant DNA experiment by assembling DNA molecules carrying genes from different organisms.

1976 Congress passes the Toxic Substances Control Act to regulate the chemicals in everyday products.

1985 Robert F. Curl, Jr., Harold W. Kroto, and Richard E. Smalley make the first observation of a new form of carbon: buckminsterfullerene, or buckyball for short.

1985 Kary B. Mullis reports the first polymerase chain reaction.

1989 The U.S. launches the Human Genome Project.

1990 Congress amends the Clean Air Act, making air pollution standards significantly tougher.

► **1991** Sumio Iijima discovers the carbon nanotube.

2001 Human Genome Project and Celera Genomics independently publish papers reporting the complete sequencing of the human genome. Pictured are J. Craig Venter (left) and Francis S. Collins.

2009 FDA approves first human clinical trial of an embryonic stem-cell-based therapy. The trial is halted two years later.

2009 NASA scientists definitively detect water on the moon.

2009 IBM researchers improve the resolution of atomic force microscopy so much that they are able to visualize all of the atom positions and bonds of a single molecule for the first time.

2011 Brian K. Koblick and Roger Sunarshra determine the first structure of a G protein-coupled receptor with its G protein partner.

► **2012** An international team discovers a new particle that they think is the Higgs boson—a long-missing particle that imbues matter with mass.

2013 The U.S. Supreme Court rules that human genes cannot be patented.

2013 C&EN turns 90.

90 C&EN CELEBRATES 90 YEARS OF

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1939 Linus C. Pauling publishes "The Nature of the Chemical Bond." The text becomes an instant classic.

► **1939** Paul Hermann Müller discovers that dichlorodiphenyltrichloroethane (DDT) is an effective insecticide.

► **1953** James D. Watson and Francis H. C. Crick determine DNA's double-helix structure.

1958 The first high-resolution protein structure debuts: John C. Kendrew and Max F. Perutz determine myoglobin's structure with X-ray crystallography.

1960 The birth control pill is approved for use in the U.S. Carl Djerassi and Alejandro Zaffaroni developed it in the 1950s from yam extracts in a lab in Mexico.

1965 Robert Burns Woodward and Rolf Hoffmann pull forth the Woodward-Hoffmann rules to explain stereochemistry in chemical reactions.

1965 DuPont chemist Stephanie L. Kwolek invents the strong but light polymer Kevlar.

1966 Weston A. Anderson and Richard R. Ernst develop Fourier transform NMR, laying the groundwork for modern NMR spectroscopy.

1967 Monroe E. Wall and Mansukh C. Wani isolate the future cancer drug, Taxol (paclitaxel) from the bark of the Pacific yew tree.

1968 George C. Cotzias shows that the psychoactive drug levodopa is effective against symptoms of Parkinson's disease.

► **1970** President Richard Nixon's executive order launches the Environmental Protection Agency.

1970 Congress passes the Clean Air Act, the first of many environmental regulatory laws in the 1970s.

1972 Paul Berg performs the first successful recombinant DNA experiment by assembling DNA molecules carrying genes from different organisms.

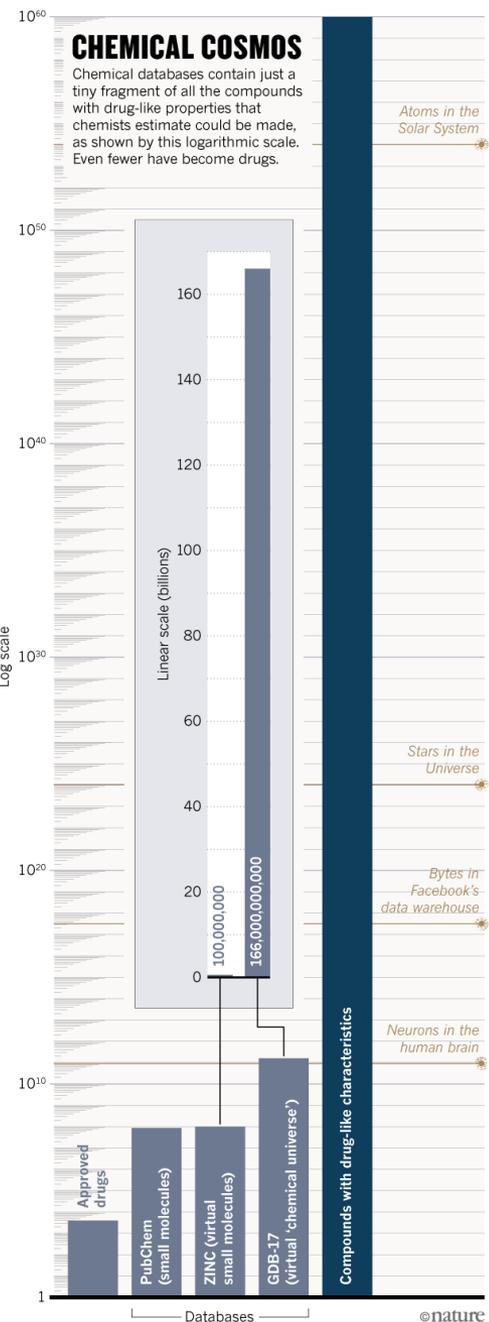
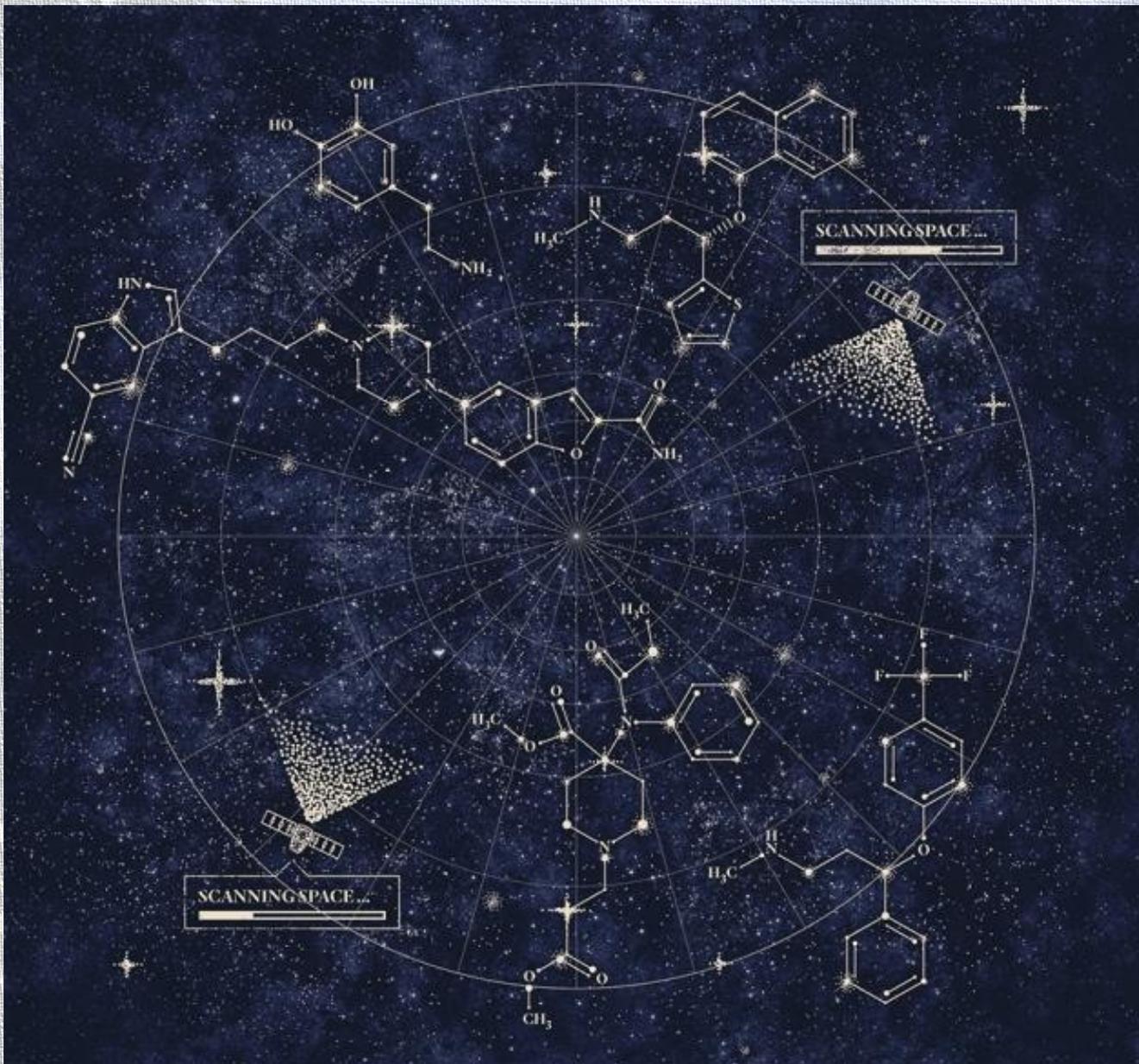
1976 Congress passes the Toxic Substances Control Act to regulate the chemicals in everyday products.

1985 Robert F. Curl, Jr., Harold W. Kroto, and Richard E. Smalley make the first observation of a new form of carbon: buckminsterfullerene, or buckyball for short.

1985 Kary B. Mullis reports the first polymerase chain reaction.

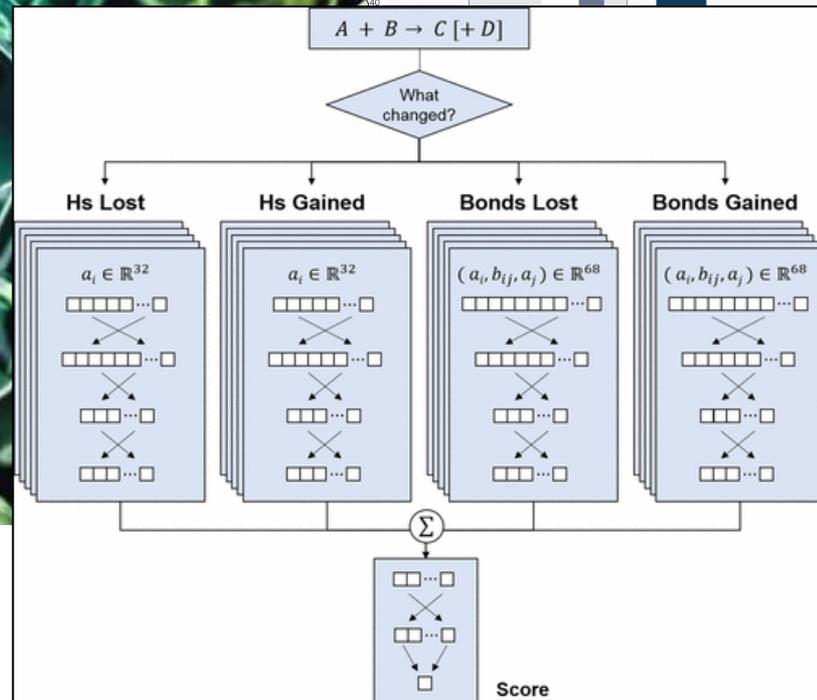
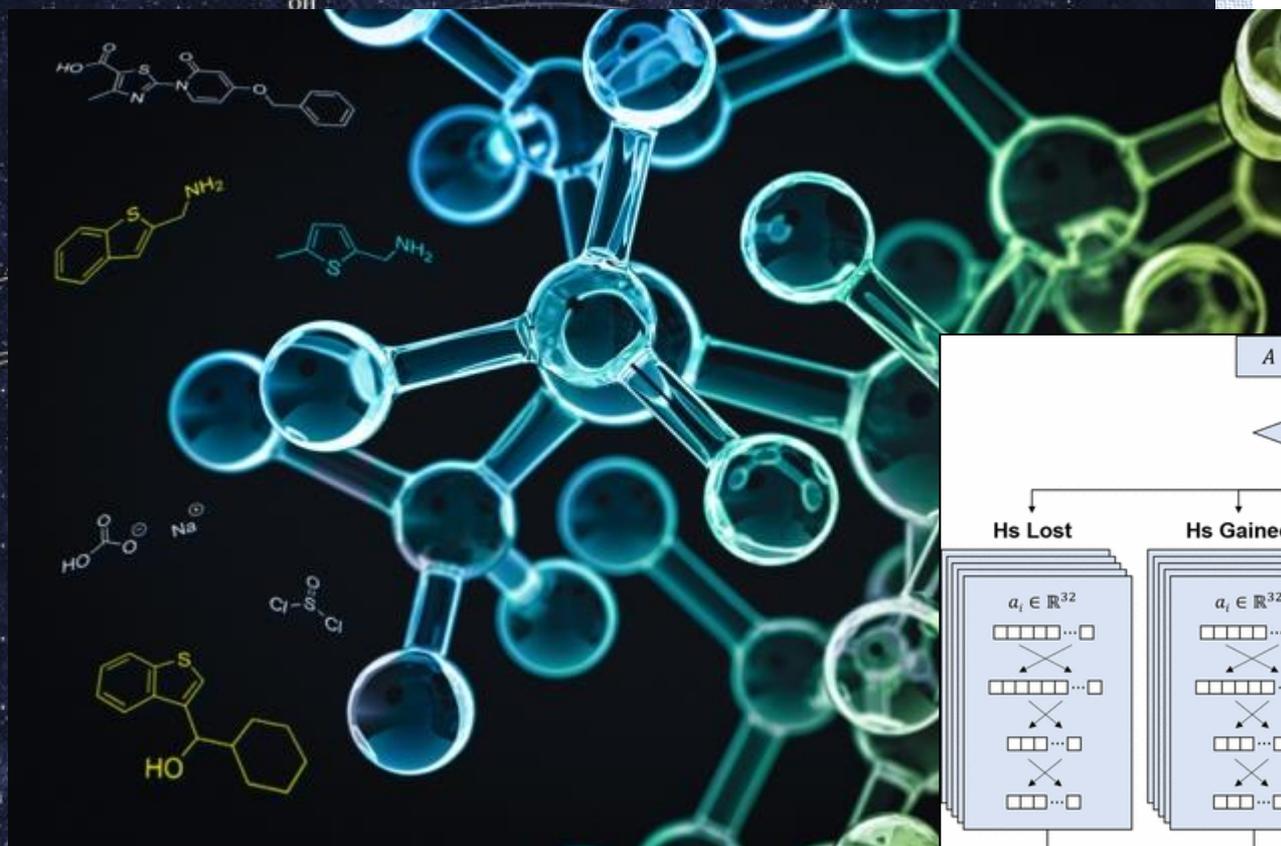
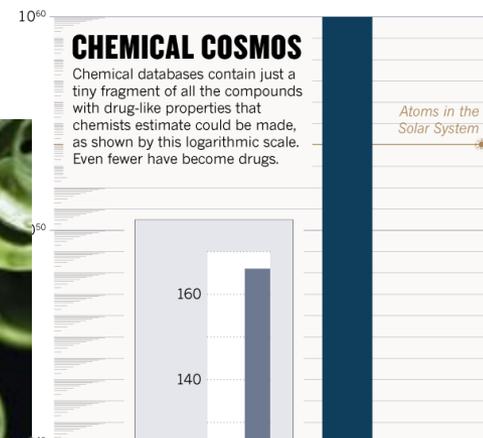
1989 The U.S. launches the Human Genome Project

The Chemical Universe



<https://www.nature.com/news/the-drug-maker-s-guide-to-the-galaxy-1.22683>

The Chemical Universe

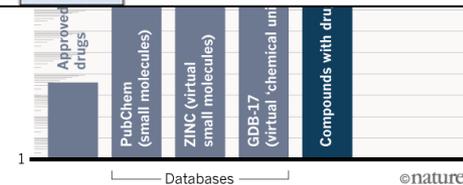


ACS
central
science

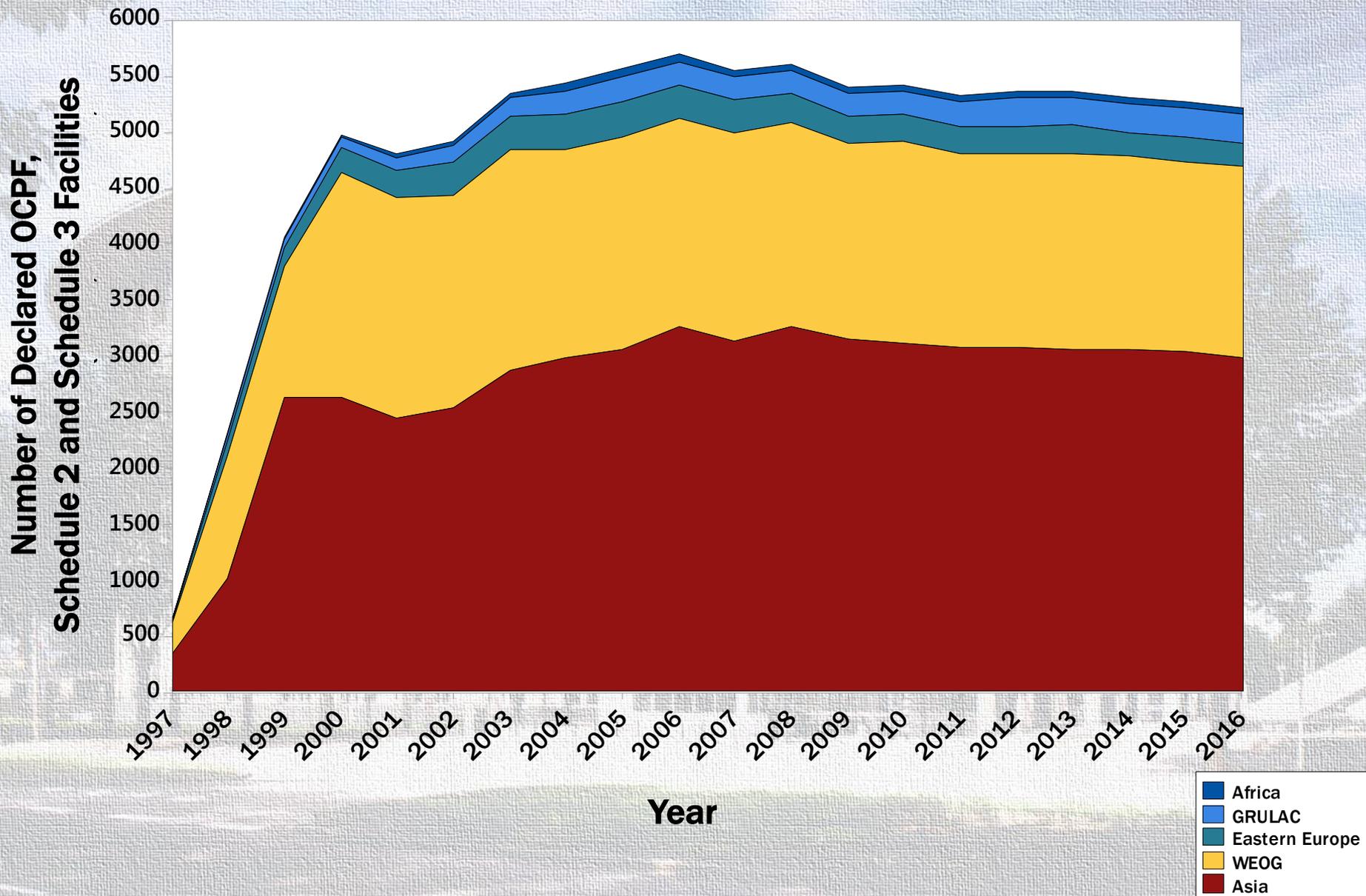
Prediction of Organic Reaction Outcomes Using Machine Learning

Connor W. Coley,[†] Regina Barzilay,[‡] Tommi S. Jaakkola,[‡] William H. Green,^{*,†} and Klavs F. Jensen^{*,†,‡}

[†]Department of Chemical Engineering and [‡]Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139, United States

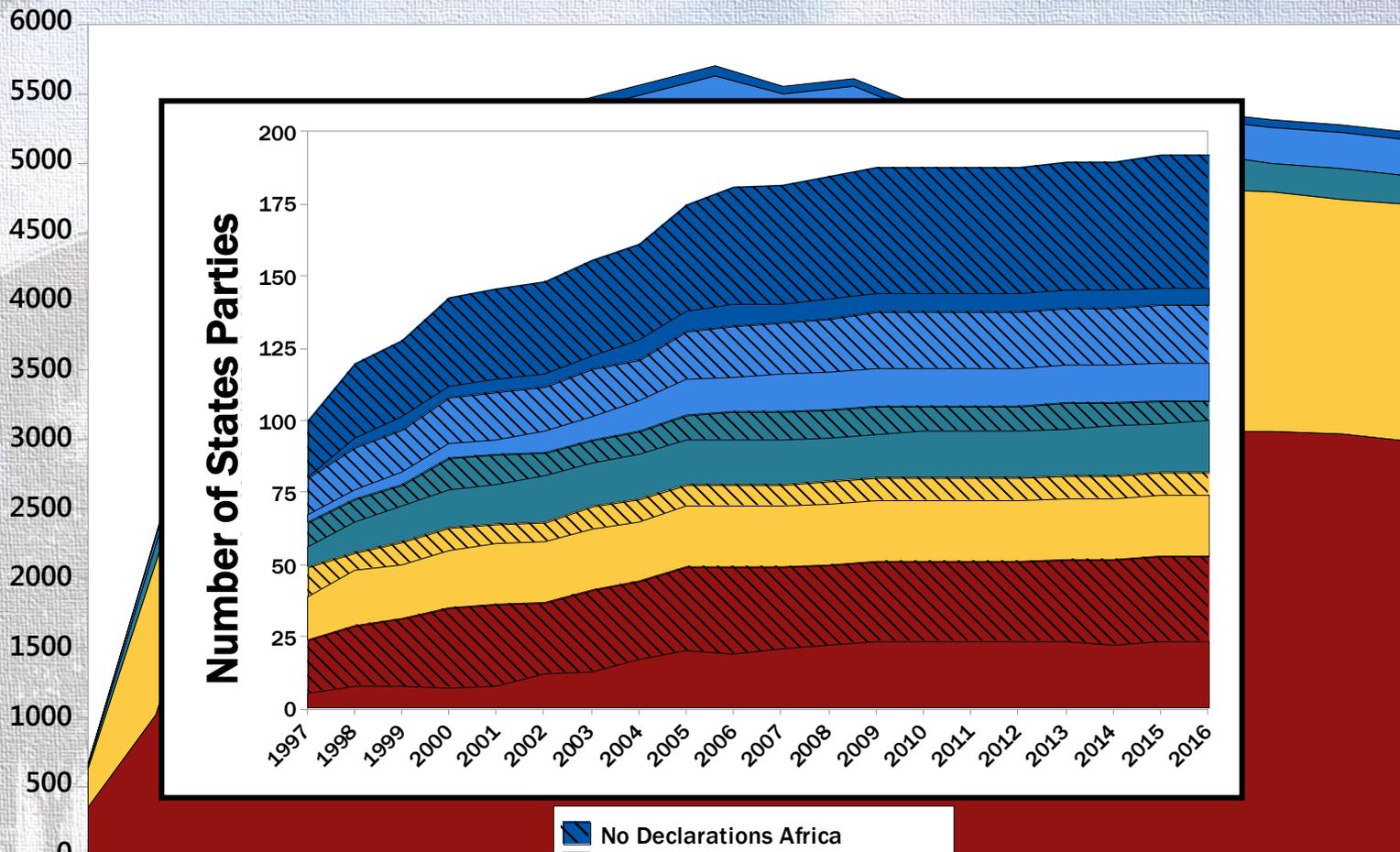


Declared Article VI Facilities



Declared Article VI Facilities

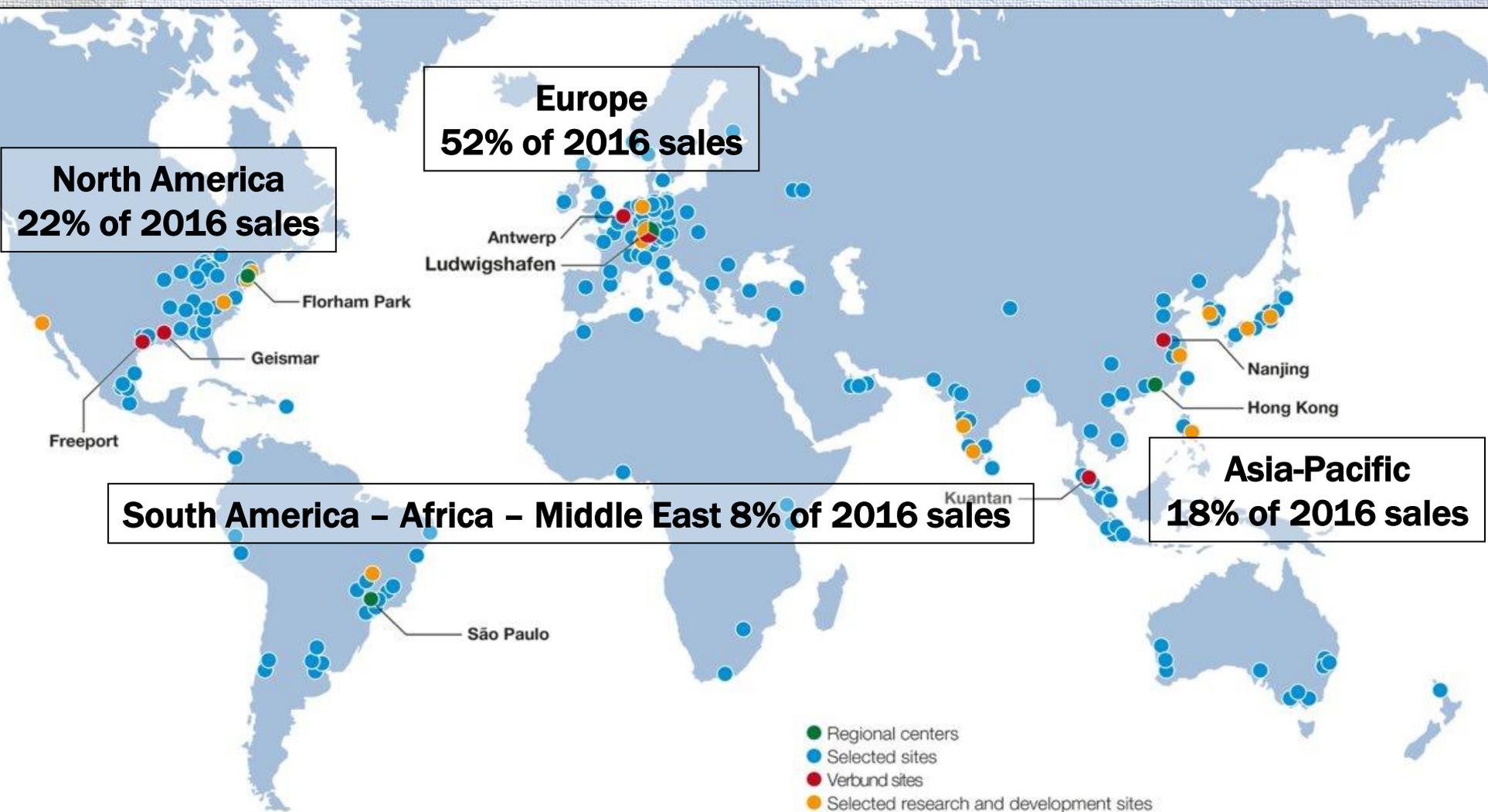
Number of Declared OCPF, Schedule 2 and Schedule 3 Facilities



- No Declarations Africa
- Declarations Africa
- No Declarations GRULAC
- Declarations GRULAC
- No Declarations Eastern Europe
- Declarations Eastern Europe
- No Declarations WEOG
- Declarations WEOG
- No Declarations Asia
- Declarations Asia

- Africa
- GRULAC
- Eastern Europe
- WEOG
- Asia

Chemical Economies



One Chemical Company: production & research facilities in > 80 States Parties!

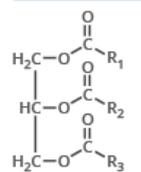
Today's Chemistry Lesson



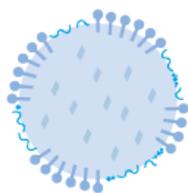
THE CHEMISTRY OF ICE CREAM

Ice cream is a combination of air, ice crystals, fat globules, and a liquid syrup. These are combined to make a colloid, a solution with very small insoluble particles suspended in it. This graphic looks in detail at the components of this colloid, and some molecules that produce ice cream flavours.

FATS, PROTEINS, & EMULSIFIERS



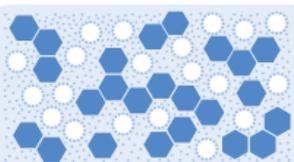
FAT (TRIGLYCERIDE)
R = fatty acids



- LIQUID FAT
- EMULSIFIER MOLECULES
- MILK PROTEINS
- FAT CRYSTALS

Fats are important for the creaminess of ice cream. Proteins from milk form a membrane around the fat droplets, making it harder for them to come in contact with each other. Emulsifiers replace some milk protein on the surface of the fat droplet. As ice cream is made, some of the fat in the droplet solidifies, and the fat 'needles' that form help droplets to partially cluster. These clusters, along with milk proteins, help stabilise air bubbles in the ice cream.

THE STRUCTURE OF ICE CREAM



● ICE CRYSTALS	30%
○ AIR BUBBLES	50%
● FAT DROPLETS	5%
■ LIQUID SYRUP	15%

% by volume for typical composition

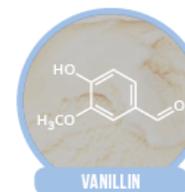
During freezing, most water is frozen into ice. Small ice crystals are needed for smooth ice cream. Beating and aeration occur at the same time as freezing to form small air bubbles, stabilised by demulsified fat. Air makes up 30-50% of ice cream's final volume. Sugar sweetens the ice cream, and lowers the freezing point of water, reducing the amount of ice. Soft ice cream contains less ice.



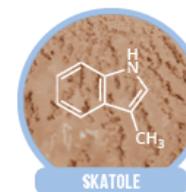
FLAVOURS AND COLOURS



ANTHOCYANINS



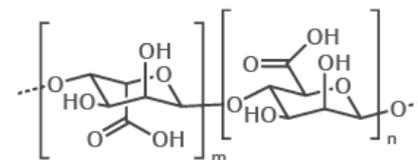
VANILLIN



SKATOLE

Natural ice cream flavours contain a number of flavour-contributing compounds. Flavouring can also be achieved artificially. Artificial vanilla flavouring is often simply vanillin; other artificial flavours are more complex. Other compounds can be used as flavour enhancers – an unusual example is skatole, also found in faeces, but which has a floral odour at lower concentrations. Colours can be added artificially; anthocyanins from plants are amongst the colouring agents used.

STABILISERS



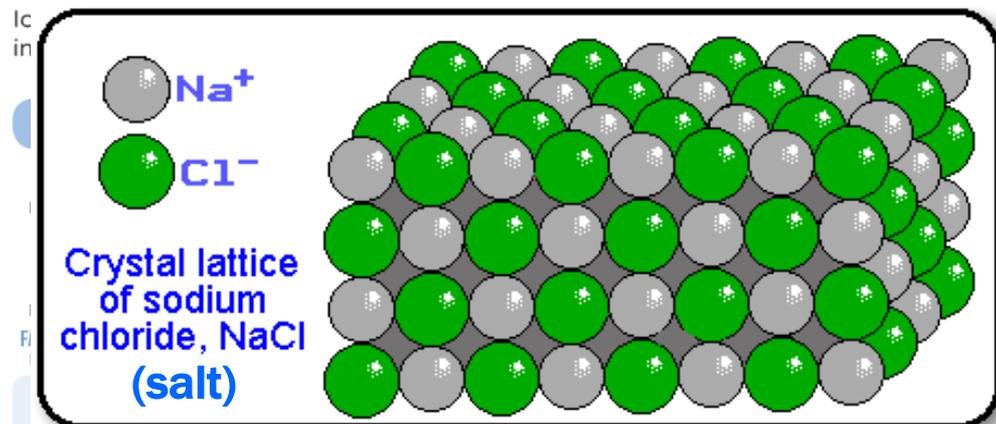
ALGINIC ACID

Sodium alginate is the sodium salt of alginic acid. Another stabiliser that can be obtained from seaweed is carrageenan.

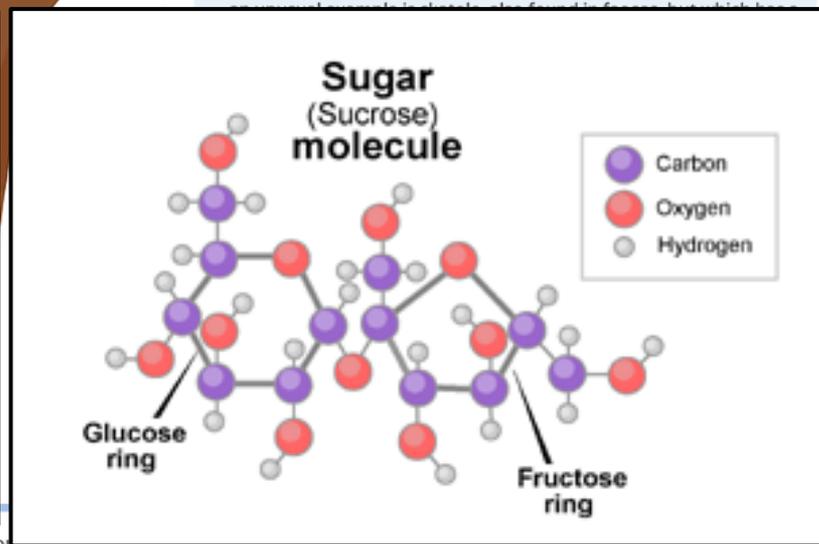
Stabilisers are added in small amounts (~0.2%) to ice cream. Often extracted from plants, a common example is sodium alginate, the sodium salt of alginic acid, extracted from brown seaweeds. Stabilisers reduce the rate at which ice cream melts, add smoothness, and increase the viscosity of the liquid phase of ice cream. Use of multiple stabilisers can produce synergistic effects.



THE CHEMISTRY OF ICE CREAM



some milk protein on the surface of the fat droplet. As ice cream is made, some of the fat in the droplet solidifies, and the fat 'needles'



Presentation by Mr Cheng Tang Vice-Chairperson OPCW SAB



OPCW



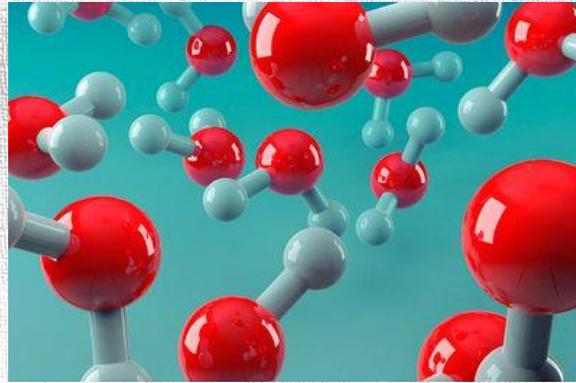


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One More Type of Chemical Process: *In-Situ* Production and Consumption



+



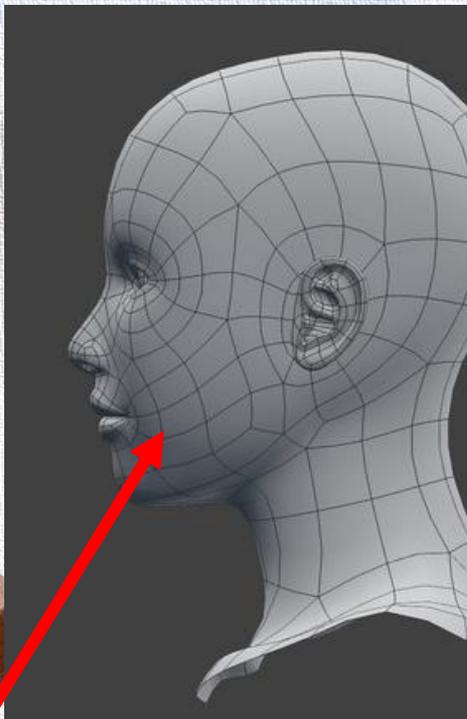
(water, H₂O)



One More Type of Chemical Process: In-Situ Production and Consumption



+



“Raw Material”

“(Bio)Chemical Reactor”

Consumed by other chemical processes as it forms

Digestion

The Digestive System

What Happens to your Food

Mouth
Food and drink are chewed, mixed with *saliva* then swallowed.

Digestive Tract
This is a tube of 7 metres which starts at your mouth and finishes at the anus.
Food passes along the tube, mixing with chemicals known as *digestive enzymes* along the way.
These enzymes split the food into smaller and smaller units which are the *nutrients* that the body needs to make it work properly. These nutrients are tiny enough to pass through the wall of the intestine and enter the bloodstream.
The blood carries the nutrients round the body to where they are needed for building, repairing and maintaining a healthy person.

Peristalsis
The food is passed through the system by a series of rhythmic muscular contractions. These wave-like contractions are called *peristalsis*. The walls of the tract contract behind the food and push it downward.

The Food Pyramid

Fats and Oils for heat and energy

Animal Proteins for growth and repair

Fruit and Vegetables for health and vitality

Carbohydrates for energy

To stay healthy, you need to eat the correct amount of food from the main food groups. The proportions of foods in a balanced diet form a pyramid.

Body Waste

The 'leftovers' from digestion have to be expelled from the body.
We produce 45,000 litres of liquid waste or urine during our lives - enough to fill a fuel tanker!
The solid waste is called *faeces*, which the body pushes out through the anus.
Our anus also releases 2 litres of gas called *flatus* every day - enough to fill a party balloon.



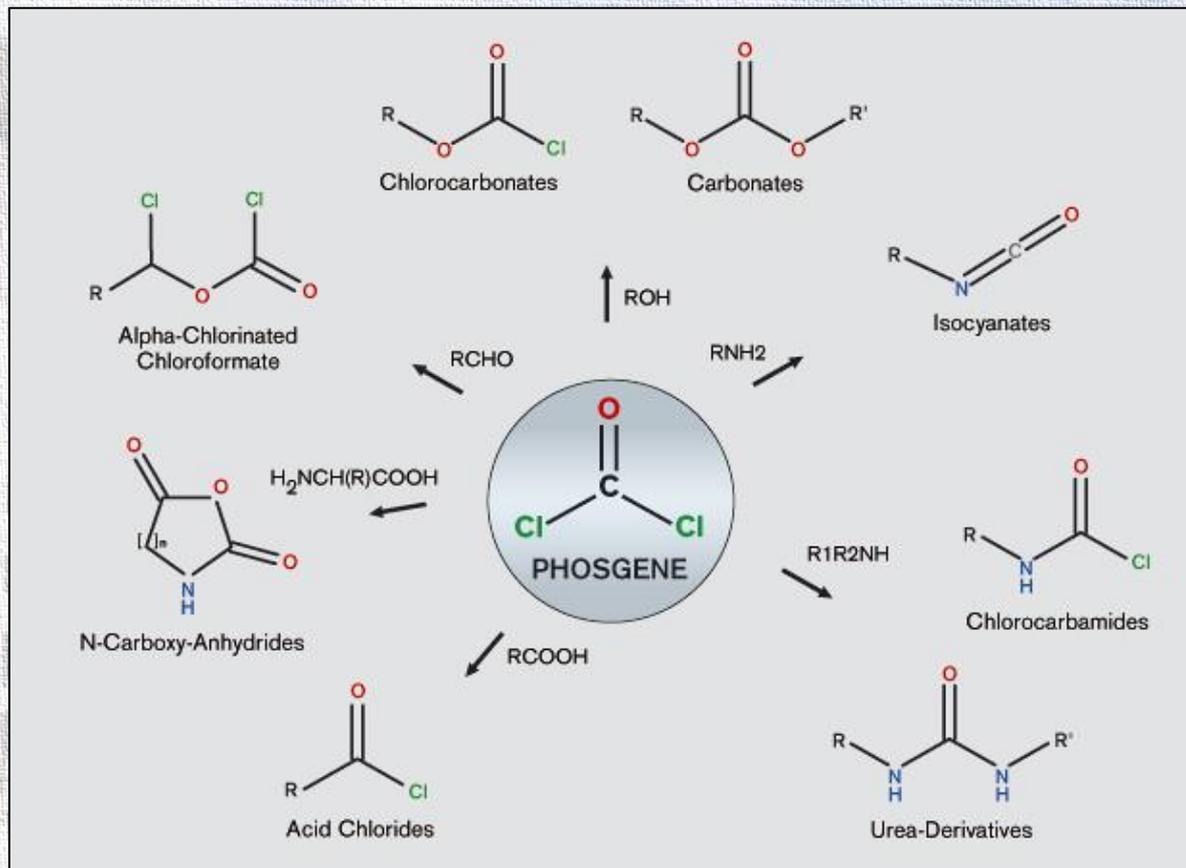
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Why Would You Do This?

SMELLS LIKE MUSTY HAY

PHOSGENE

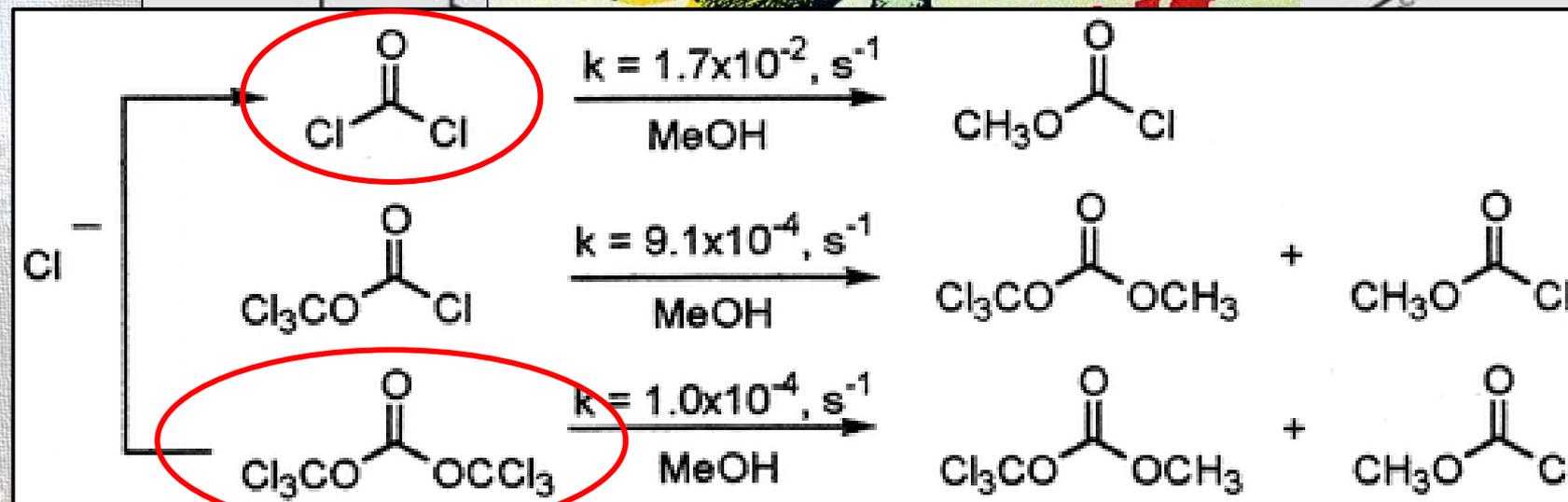
OR GREEN CORN • LUNG IRRITANT • CAUSES INCREASED DOPEY FEELING • COLORLESS GAS



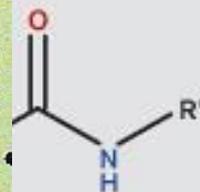


Why Would You Do This?

SMELLS LIKE MUSTY HAY



OR GREEN CORN • LUNG IRRITANT • CAUSES
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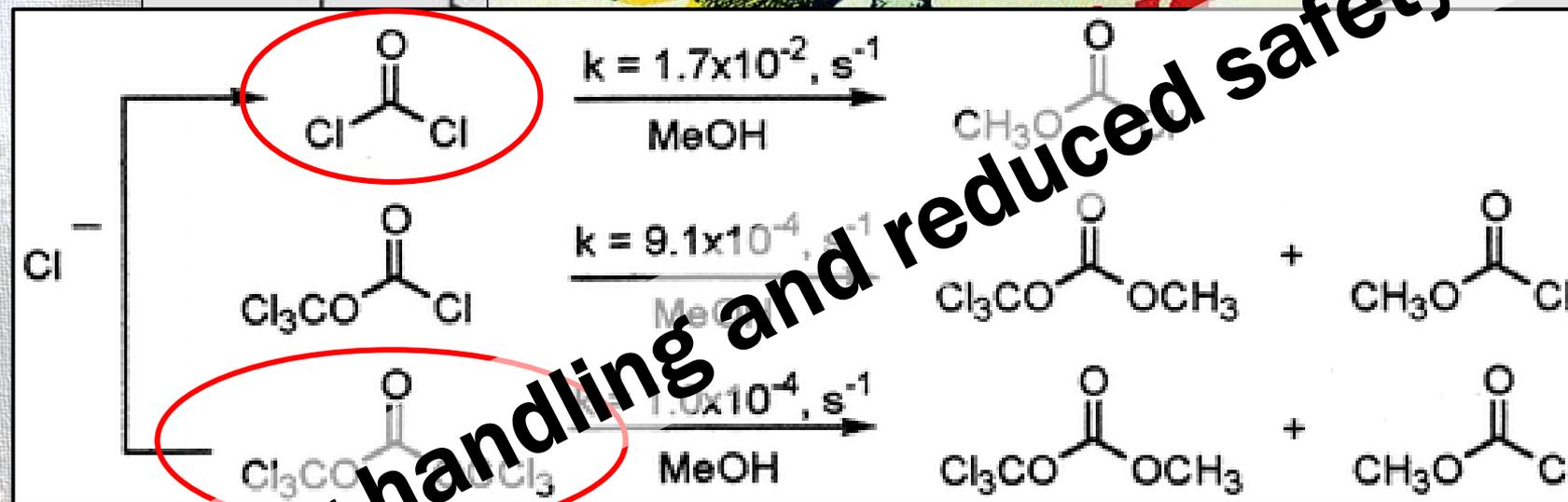


Derivatives



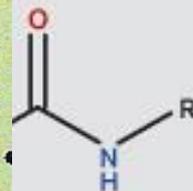
Why Would You Do This?

SMELLS LIKE MUSTY HAY



Safer handling and reduced safety risks

OR GREEN CORN • LUNG IRRITANT • CAUSES
INCREASED DOPEY FEELING • COLORLESS GAS



Derivatives



The Scientific Advisory Board with the OPCW Director-General at their 25th Session (March 2017)

The OPCW Scientific Advisory Board (SAB)

"To enable the Director-General, in the performance of his functions, to render specialized advice in areas of science and technology relevant to this Convention, to the Conference, the Executive Council or States Parties."

- CWC Article VIII, Paragraph 21(h)

Nationalities of SAB members in 2017



The membership of the Scientific Advisory Board includes experts from 25 States Parties each serving up to two consecutive 3 year terms.

The boundaries and names shown on this map do not imply official endorsement or acceptance by the Organisation for the Prohibition of Chemical Weapons. The final boundary between the Republic of India and the Republic of South Sudan has not yet been determined. The dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).

Topics considered in 2017 :

- >> Emerging technologies
- >> Nanotechnology
- >> Toxins
- >> Verification
- >> Medical countermeasures and treatment
- >> Chemical forensics and investigative technologies
- >> Trends in chemical production

Recent Reports:

Report of the Scientific Advisory Board

25th Session

(SAB-25/1, dated 31 March 2017)

24th Session

(SAB-24/1, dated 28 October 2016)

23rd Session

(SAB-23/1, dated 22 April 2016)

Response to the Director-General's Request to the Scientific Advisory Board to Provide Further Consideration on Which Riot Control Agents are Subject to Declaration Under the Chemical Weapons Convention

(SAB-25/WP-1, dated 27 March 2017)



Report of the Scientific Advisory Board's workshop on Chemical Warfare Agent Toxicity, Emergency Response and Medical Countermeasures (SAB-24/WP-2, dated 14 October 2016)



Report of the Scientific Advisory Board's Workshop on Chemical Forensics (SAB-24/WP.1, dated 14 July 2016)



Response to the Director-General's Request to the Scientific Advisory Board to Provide Further Advice on Chemical Weapons Sample Stability and Storage (SAB-23/WP.2, dated 25 May 2016)



Response to the Director-General's Request to the Scientific Advisory Board to Provide Further Advice on Scheduled Chemicals (SAB-23/WP-1, dated 28 April 2016)



Report of the Scientific Advisory Board at its Twenty-Fifth Session
(SAB-25/1*, dated 31 March 2017)
URL: <http://q-r.to/bap1L1>



The Impact of the Developments in Science and Technology in the Context of the Chemical Weapons Convention, Response from the Director-General to SAB-25
(EC-85/DG.8, dated 19 May 2017)
URL: <https://q-r.to/bap1L0>



Report of the Scientific Advisory Board at its Twenty-Sixth Session
(SAB-26/1, dated 20 October 2017)
URL: <http://q-r.to/bap1La>



Response to the Director-General's Request to the Scientific Advisory Board to Provide Consideration on which Riot Control Agents are Subject to Declaration under the Chemical Weapons Convention
(SAB-25/WP.1, dated 27 March 2017)
URL: <https://q-r.to/bap1Li>



Report of the Scientific Advisory Board's Workshop on Emerging Technologies
(SAB-26/WP.1, dated 21 July 2017)
URL: <http://q-r.to/bap1Ln>



Report of the Scientific Advisory Board's Workshop on Trends in Chemical Production
(SAB-26/WP.2, dated 19 October 2017)
URL: <http://q-r.to/bap1Lr>



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1997 **20** YEARS

serving up to two consecutive 3 year terms.

Map: Modified from Map No. 4179 Rev. 13, UNITED NATIONS. The boundaries and names shown on this map do not imply official endorsement or acceptance by the Organisation for the Prohibition of Chemical Weapons. The final boundary between the Republic of India and the Republic of South Sudan has not yet been determined. The dotted line represents approximately the line of control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).

 to the Scientific Advisory Board to Provide Consideration on Which Riot Control Agents are Subject to Declaration Under the Chemical Weapons Convention (SAB-25/WP.1, dated 27 March 2017)

 Scientific Advisory Board to Provide Further Advice on Scheduled Chemicals (SAB-23/WP.1, dated 28 April 2016)



Session (March 2017)

ologies

Scientific Advisory Board's workshop on Emerging Technologies (SAB-26/WP.1, dated 21 July 2017)

Scientific Advisory Board's Workshop on Trends in Chemical Production (SAB-26/WP.2, dated 19 October 2017)

Director-General's Request to the Scientific Advisory Board to Provide Further Advice on Scheduled Chemicals (SAB-23/WP.1, dated 28 April 2016)

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URL: <http://q-r.to/bap1Lr>



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**SAB-27
19-23 March 2018
States Parties Briefing
RC-4 Report**

serving up to two consecutive 3 year terms.

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to the Scientific Advisory Board to Provide Consideration on Which Riot Control Agents are Subject to Declaration Under the Chemical Weapons Convention (SAB-25/WP.1, dated 27 March 2017)

Scientific Advisory Board to Provide Further Advice on Scheduled Chemicals (SAB-23/WP.1, dated 28 April 2016)

Director-General's Request to the

Scientific Advisory Board's workshop on Agent Toxicity, Emergency Countermeasures (October 2016)

Scientific Advisory Board's Workshop on Emerging Technologies (July 2016)

Director-General's Request to the Board to Provide Further Advice on Scheduled Chemicals (May 2016)





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) can be used in the safe and non-destructive measurement of 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 to ensure the chain of custody and verifying authenticity, especially in regard to digital images and 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?



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

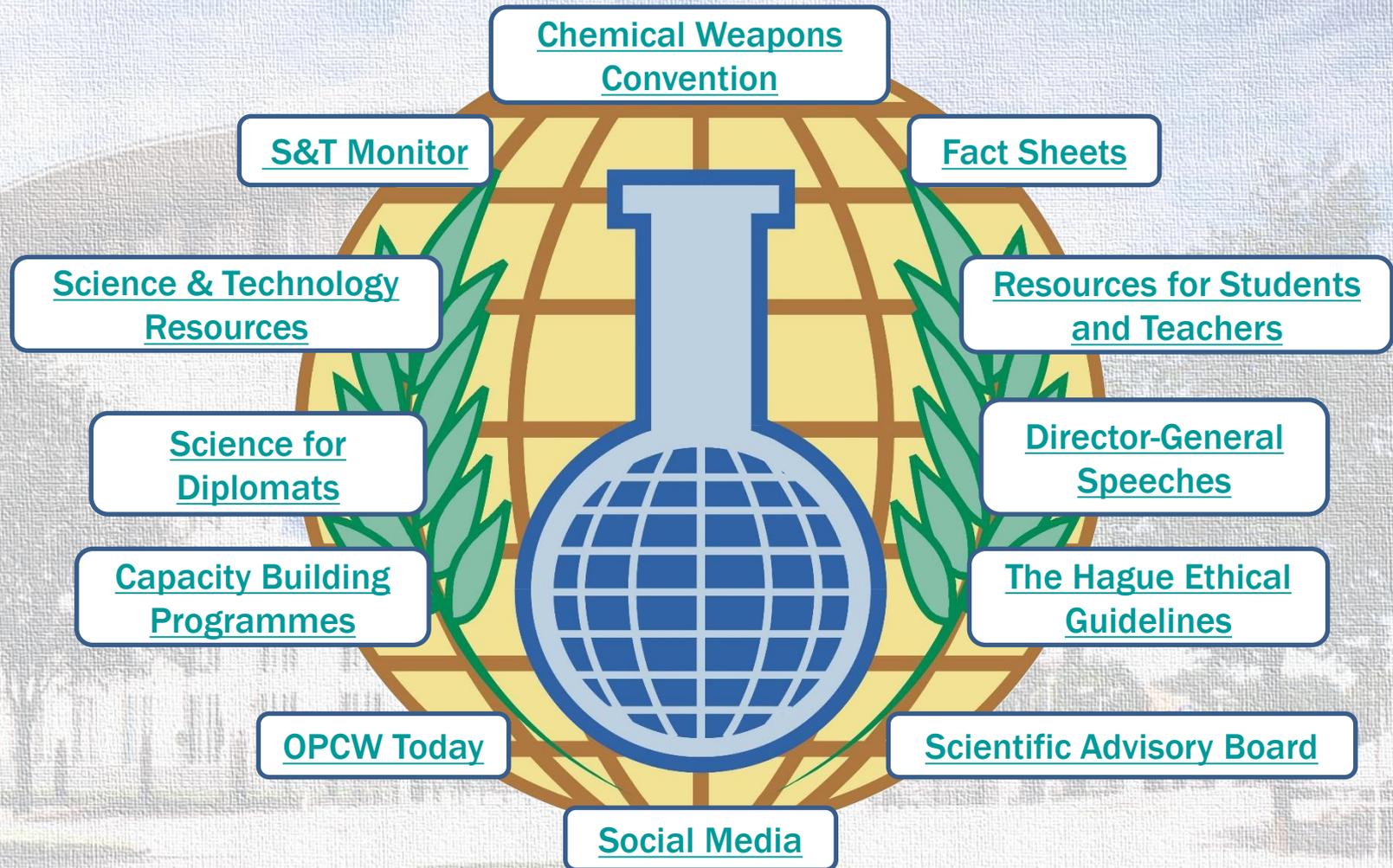
First Meeting February 2018





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OPCW Science and Technology Resources



OPCW Science and Technology Resources



The OPCW Science & Technology Monitor
 A sampling of Science & Technology Relevant to the Chemical Weapons Convention
 Volume 3 Number 3
 6 July 2016

In this Issue

- 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](#).
- Medicines, Drugs and Pharmaceuticals: CBR Arming Chemicals**
- Artificial Intelligence**
- The S&T Puzzle**
- SAB, ABDO and OPCW Day reports**

Sound 1
Sound 2
Sound 3

Science for Diplomats at the OPCW 2014 - 2015

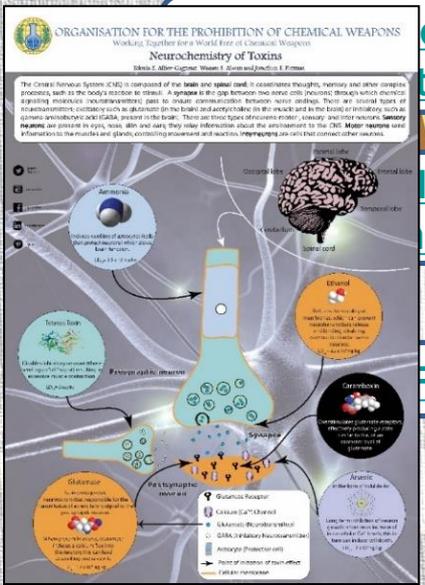
ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Applying the norms of the practice of chemistry to support the Chemical Weapons Convention

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 /OPCW/COMPANY
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THE HAGUE ETHICAL GUIDELINES

ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS



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PCW Today

Social Media

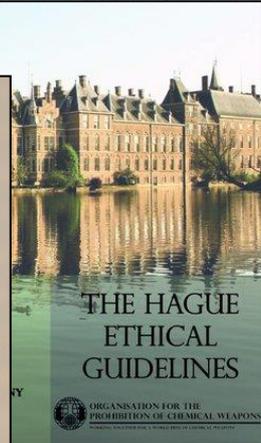
VERIFICATION

REPORT OF THE SCIENTIFIC ADVISORY BOARD'S TEMPORARY WORKING GROUP

June 2015

ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

OPCW Science and Technology Resources



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