



The OPCW Science & Technology Monitor

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

10 July 2015

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22nd Session of the OPCW Scientific Advisory Board

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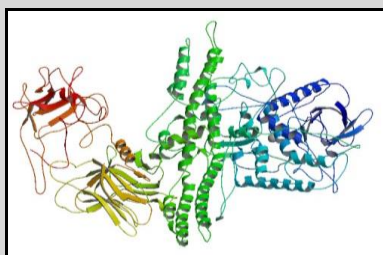


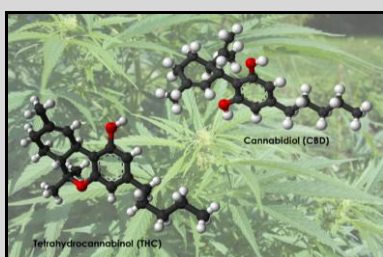
Image from [Protein Data Bank](#) (structure 3BTA).

Protein structure of botulinum toxin



Image from [beautynz](#).

Chemistry of cosmetics



Cannabinoids

Welcome

Welcome to the *OPCW Science and Technology Monitor*, an occasional bulletin to provide updates on developments in science and technology across a broad spectrum of topics relevant to the CWC. Past issues are available from the [Science and Technology section of the OPCW website](#).

Today marks the birthday of [Edward Lowe \(1920-1995\)](#), the accidental inventor of "[kitty litter](#)"; an absorbent material that is now found in cat boxes around the world. We highlight this inventor for his support of new and unusual ideas, and we point out that absorbent materials are routinely used [to protect us from](#) and to [collect samples](#) of chemical agents. Absorbent materials can also be used to [capture toxic chemicals from the environment](#).

The S&T Puzzle

In the tightest contest yet for winning the prize, our friends at the [CTBTO](#) submitted their correct answers a mere minute ahead of a member of the OPCW staff! These answers were of course: LD₅₀ of water = 0.08 liter/kg bodyweight, Molarity of Caffeine in a cup of coffee falls in the range of 0.0016 – 0.0021 mol/liter, and LD₅₀ of coffee itself = 1.57 cups/kg bodyweight). Congratulations for a job well done! Puzzle statistics now stand at: VER 4, OSP 2, OCS 1, INS 1 and CTBTO 4.

For this edition of the puzzle, we ask you to find the collection of words that make up the section titles of the *S&T Monitor* in the word search puzzle below (twenty-five words in all). Circle the words and send us an image of the completed puzzle, whoever finds the most correct words wins the prize: a choice of requesting a featured topic, designing a puzzle, or receiving a beverage hand selected by the Science Policy Adviser. Send answers by [email](#). Good luck!

G	R	Z	Y	C	S	U	T	S	H	Q	W	N	C	C
D	G	D	R	R	C	B	P	O	A	A	R	O	A	O
N	M	N	O	V	I	P	K	D	X	I	N	I	N	S
O	G	U	S	L	E	L	S	G	A	I	S	S	N	M
C	I	F	I	T	N	E	I	C	S	T	N	S	A	E
E	W	F	V	Q	C	A	F	Y	C	M	E	E	B	T
S	K	H	D	Q	E	Y	R	U	L	U	W	S	I	I
S	B	O	A	R	D	T	D	X	T	N	S	U	N	C
C	R	O	W	D	S	O	U	R	C	I	N	G	O	S
W	C	P	O	I	R	D	E	T	A	L	E	R	I	W
C	I	R	M	P	U	Z	Z	L	E	U	V	J	D	N
Q	P	E	R	S	O	N	A	L	N	T	E	B	S	N
D	H	W	E	L	C	O	M	E	V	O	N	R	X	A
C	G	N	I	M	O	C	P	U	B	B	T	B	A	K
Y	T	N	E	W	T	H	B	Z	A	M	S	P	B	C

Science Fun:

Through today's edition of *Science Fun*, we congratulate our colleagues here at the OPCW on a series of birth announcements that all took place within the past few weeks! Do we have future scientists? Future diplomats? Or perhaps future motorcycle racers or beer brewers? Only time will tell, and we look forward to watching them all grow. To celebrate, we look at some of the [science of babies!](#)



Image from [The New York Times](#).
(Fatherhood Has Its Rewards, Like That \$1,700 Stroller).

Do you remember the milestones you reached in the first hour after birth? [Perhaps not](#) (and [for good reason](#)), so [here is a little reminder!](#) You probably don't remember what the world looked like as new-born either; but [you can experience it again with the help of computers](#) as shown by a [recent study](#). Does a baby's behaviour have a scientific basis? Studies suggest that new-borns who recognise familiar [smells](#) and experience [skin to skin contact](#) may be more adept at [finding their favourite sources of nutrition!](#) [Babies even produce their own smells to help their parents too!](#)

Parents might also want to talk to their babies to help [boost brain power](#) which is an [especially important job for parents of premature babies](#).

News and Updates

Recent reports and publications:

[Report of the Second Meeting of the United Nations Secretary-General's Scientific Advisory Board](#) and summary of the [Third Meeting](#).

A look at [the good, the bad and the unknown of the DNA-Editing technology CRISPR](#).

[Nature Index 2015 Global](#).

[Report](#) from the Workshop on lessons learned from the international maritime operation for the removal and transport of Syrian chemical materials.

[June 2015 issue of Dstl's Insight](#).

[IAEA Bulletin Volume 56-2 \(June 2015\)](#).

The [ABCs of Sustainable Production and Consumption](#) from UNEP.

The [Social Innovation Lab Guide](#) from Waterloo Institute for Social Innovation and Resilience.

The [report](#) on the [public attitudes to chemistry study](#) in the United Kingdom from the Royal Society of Chemistry.

Is there a link between political party and views on science? Take a look at [Americans, Politics and Science Issues](#).

[Report from Geneva: The Biological Weapons Convention Fortieth Anniversary of the Entry into Force](#).

Science and education resources:

Examples of the [use of new technologies for treaty verification](#) from the James Martin Center for Non-Proliferation Studies.

[Project Ignite](#). 3D Printing resources for teachers and schools.

[Test your knowledge of chemical hazard symbols and pictograms](#) with this quiz.

[How to give a science flash talk](#) – some tips and advice for science communication.

Some news from world of science and technology:

From the weeks of [31 May – 6 June](#), [7 – 13 June](#), [14 – 20 June](#), [21 - 27 June](#) and [28 June – 4 July](#) in chemistry.

Did you know that babies [recognize the sound of their mothers voices and heartbeat before birth](#)? For those of you thinking about what to say to a baby, consider if you should be speaking in [“parentese”](#) (which includes dialects such as [“motherese”](#) and [“fatherese”](#)) or standard speech – it could influence future language development! [Bilingual babies can even teach adults a thing or two!](#) Does [Music help](#)? It may, but [it depends on who you ask!](#)

We all know that parents play a vital role in the development of a child, yet we always hear that there is no manual, but we have found [some online lessons](#) (and some [resources for science minded parents](#)). For those who would like to see their babies contribute to science, there are plenty of [science experiments that can be done at home](#) and [babies can contribute to global scientific knowledge just by laughing!](#) There is plenty of science and technology to keep parents ([especially fathers](#)) occupied too, and the new gadgets are [much less terrifying than some of the options available in the 20th century.](#)

Crowdsourcing:

[Contribute to saving lives and promoting clean energy uptake throughout Africa](#) (and win a reward) by submitting your ideas on recycling liquid petroleum gas cylinders.

Do you have any innovative and environmentally sustainable ideas? If so, submit a proposal to the [Green and Sustainable Chemistry Challenge!](#)

Do you have a talent for visualising science and engineering? Submit your work to the [Vizzies!](#)

Twenty-Second Session of the OPCW Scientific Advisory Board

We thank the Secretary to the SAB for his contributions to this feature



The [OPCW Scientific Advisory Board \(SAB\)](#) held its [Twenty-Second session from 8 to 12 June 2015](#) at OPCW Headquarters in The Hague under the chairmanship of Dr Christopher Timperley (United Kingdom and Northern Ireland), with Mr Cheng Tang (China) serving as Vice-Chair. Deputy Director-General, Ambassador Grace Asirwatham, delivered the [opening statement](#) on behalf of the OPCW Director-General, noting that “Science and technology are ingrained in the Chemical Weapons Convention”.

During the session, the SAB endorsed the [report received from its Temporary Working Group \(TWG\) on verification](#) and submitted [a report with further advice on medical countermeasures for exposure to nerve agents](#) (this report was further discussed at the July [Science for Diplomats](#) briefing). Commenting on the reports, Dr Timperley noted, “Verification is at the heart of the Chemical Weapons Convention, and we hope our advice will better inform the OPCW’s efforts to achieve a world free of chemical weapons.” [A briefing by the Chair and Vice-Chair to OPCW States Parties on the activities of the SAB](#) was also held.



[A call for evidence-informed ideas to provide new insights in international responses to new threats and challenges to peace, security, and development.](#)

Upcoming S&T Related Events:

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

14 – 26 July 2015

[19th Annual Green Chemistry and Engineering Conference.](#)
Bethesda, ML, USA.

19 – 22 July 2015

[12th World Congress on Industrial Biotechnology.](#)
Montreal, Canada.

28 – 30 July 2015

[International Society for the Philosophy of Chemistry \(ISPC 2015\).](#)
Rio de Janeiro, Brazil.

6 – 13 August 2015

[48th IUPAC General Assembly and 45th World Chemistry Congress.](#)
Busan, Republic of Korea.

10 - 14 August 2015

[Biological Weapons Convention Meeting of Experts.](#)
Geneva, Switzerland.

16 – 20 August 2015-05-25

[250th American Chemical Society National Meeting and Exhibition.](#)
Boston, MA, USA.

24 – 27 August 2015

[FinMedChem 2015.](#)
Helsinki, Finland.

31 August – 4 September 2015

[Sixth Summer Programme on Disarmament and Non-Proliferation of Weapons of Mass Destruction \(WMD\) in a Changing World.](#) Asser Institute, The Hague, The Netherlands.

3 – 4 September 2015

[The International Conference On Chemical Sciences And Engineering \(CHEMSCIE 2015\).](#)
Veracruz, Mexico.

The session included contributions from three guest speakers: Professor Åke Sellström on lessons identified from the [2013 United Nations Investigation into Alleged Uses of Chemical Weapons in the Syria Arab Republic](#), which he led; Dr Istvan Gyarmati in his capacity as Chairperson of the [Advisory Board of the Secretary-General of the United Nations on Disarmament Matters](#); and Dr Daan Noort ([The Netherlands Organisation for Applied Scientific Research](#)) on chemical forensics.

Developments related to the [convergence of chemistry and biology](#) (including green chemistry), and [education and outreach](#) were also discussed during the session. To prepare its comprehensive report to the Fourth Review Conference of the Chemical Weapons Convention, the SAB will meet twice in 2016 and in 2017. A report on the 22nd session of the SAB will be issued shortly, followed by the Director-General's response.

We thank the SAB for their contributions to the work of the OPCW and leave you messages of science and peace from some of our SAB members.



Botulinum Toxin

Botulinum toxin is a potent neurotoxin that is produced by [Clostridium Botulinum](#) (an anaerobic, Gram-positive, spore-forming rod-shaped bacteria). The toxin causes [paralysis by blocking the action of the neurotransmitter acetylcholine](#). *Clostridium botulinum* is found in [soils](#) and [sediments](#); in intestinal tracts of [fish](#) and [mammals](#); and in [gills and viscera of shellfish](#). Under certain (low oxygen) conditions toxins may be produced; such conditions include [improperly canned foods](#), [minimally heated chilled food that has not been adequately refrigerated](#), and contaminated wounds. *Clostridium botulinum* produces serologically distinct botulinum toxin types ([A](#), [B](#), [C₁](#), [C₂](#), [D](#), [E](#), [F](#) and [G](#)). [Human botulism is caused primarily by toxin types A, B, or E and rarely F.](#)

With a [Median Lethal Dose \(LD₅₀\) approximately 100,000 times smaller than that of sarin](#) and historical examples of botulinum toxin produced for state sponsored biological warfare programmes, concerns have been raised over the possibility

13 – 16 September

[1st International Workshop on Mobile Learning \(WmL'15\)](#).
Lodz, Poland.

20 – 24 September 2015

[9th International Conference on Instrumental Methods of Analysis-Modern Trends and Applications \(IMA2015\)](#). Kalamata, Greece.

27 September – 1 October 2015

[ECCE10 \(10th European Congress of Chemical Engineering\)](#); [ECAB3 \(3rd European Congress of Applied Biotechnology\)](#); and [EPIC5 \(5th European Process Intensification Conference\)](#).
Nice, France.

5 - 8 October 2015

[SOLVE](#).
Cambridge, MA, USA.

6 October 2015

["Science for Diplomats"](#). Data Analytics and the CWC: An Introduction to OCPF Site Selection Methodology. 13:30 – 15:00 Ooms Room
OPCW Headquarters, The Hague, Netherlands.

15 October 2015

[Smart Manufacturing Summit](#).
Livermore, California, USA.

31 October - 2 November 2015

[The Port Hackathon](#).
CERN

4 – 7 November

[World Science Forum](#).
Budapest, Hungary.

16 – 19 November 2015

[Malta Conference](#).
Rabat, Morocco.

18 – 21 November 2015

[16th Asian Chemical Congress](#).
Dhaka, Bangladesh.

22 – 27 November 2015

[2nd African Conference on Research in Chemical Education \(ACRICE\)](#).
University of Venda,
Thohoyandou, South Africa.

botulinum toxin might be used as a [biological weapon](#). For example, the potential for an intentional botulinum contamination of milk has been [mathematically modelled](#), [the subject of newspaper editorials](#) and actually [experimentally tested](#).



Despite how often it is referred to as [one of the most poisonous biological substances known](#), botulinum toxin finds use in a number of [clinical treatments and even in cosmetics](#) (BOTOX® for example); a [convergence of medicine and neurotoxins!](#) Clinical conditions that can be treated with botulinum toxin include [lower urinary tract function](#); [tetanus](#); [migraine](#) and other [chronic pain](#); and [neurological disorders](#).

[Cosmetic](#) use involves the injection of very low doses of the [type A toxin](#) under the skin; usually on the face to smooth out wrinkles. [Formulations for cosmetic use continue to be patented](#) and can include [claims that cover use of alternate neurotoxins \(saxitoxin for example\) in the formulation](#). Botulinum toxin therapeutics and cosmetics are generally considered safe; however, [reports of adverse effects are not unknown](#).

Chemistry of Personal Care Products and Cosmetics

We thank Julie Foucqueteau, Kyungsin Kim and Diana Pyrikova from OPCWs Media and Public Affairs Branch for their contributions to this feature and interest in learning a bit of chemistry. We wish all of them the best of luck as they move onward from their OPCW internships.

While it is a strange thought that a substance as toxic as botulinum is a common cosmetic treatment, the use of toxic substances in cosmetics is nothing new. [Beauty practices from the ancient world](#) give an all new meaning to the age old saying "beauty is pain". Toxic lead based chemicals seem to have been popular: [Laurionite \(PbOHCl\) and phosgenite \(Pb₂Cl₂CO₃\) applied as eyeliner in ancient Egypt](#) (which may have actually had a health benefit for warding off disease) and [lead face powder](#) in the European royal courts of the 17th century just to name a few. Today [beauty products](#) are [a multi-billion dollar industry](#) that has maintained an average growth rate of [4.5% per year over the past two decades!](#)

Given the history of toxic substances in personal care products, we thought it might be worth a look at some of the [modern chemicals we wilfully treat ourselves with](#). In the 21st century, personal care often starts out with [soap](#), [shampoo](#) and [fluoride containing toothpaste](#). Soap is especially [important for health and hygiene](#) (details [here](#)).

14 - 18 December 2015

Biological Weapons Convention
Meeting of States Parties.
Geneva, Switzerland.

15 – 20 December 2015

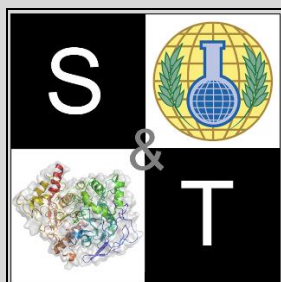
[Pacifichem 2015.](#)

Honolulu, Hawaii, USA.

Contact Us:

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](#).



Some of the chemicals found in Julie's personal care products

Some of us go on to apply [shaving cream](#) (which can contain the [Schedule 3 chemical triethanolamine](#)) and/or [hair gel](#); and perhaps beauty products such as [lipstick](#) (which might contain [castor oil, an oil that comes from the same plant that gives us ricin](#)) and/or [nail polish](#) ([which might leave behind flakes that can link a person to a crime scene](#)). If your make-up kit includes body paint and you find yourself on an [investigation of alleged](#) use, you might be interested in learning how [latex body paints can be used to sample chemical agents](#).

For hair, longer lasting cosmetic treatments ([hair dyeing](#)) may be preferred, However, [be very careful how you treat your hair](#), all it takes is [surface-enhanced-Raman-spectroscopy \(SERS\)](#) to identify not only if your hair is dyed, but also what brand of dye you used!

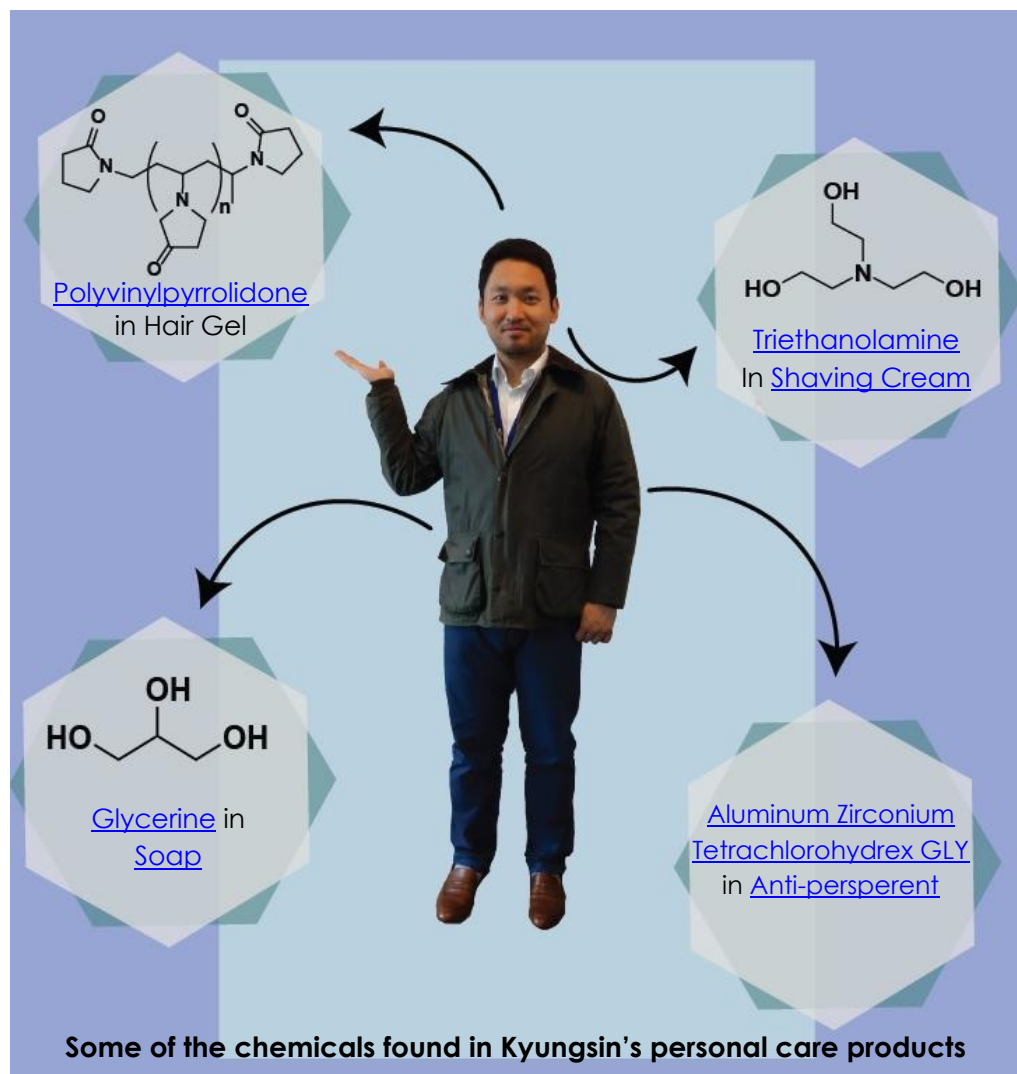
Protection from sun exposure employs [sunscreens](#) that contain titanium dioxide (for absorbing and scattering UV light) mixed with organic compounds (that absorb specific wavelengths of UV). [UV absorbing compounds can also be generated through metabolic processes](#) in some species of fish (and these metabolic processes can be transferred into to yeast for production of cosmetic components). [Tanning without UV is also possible through chemistry](#).

Spending time in the sun can induce [sweating](#), a process associated with [foul odours](#) which has created a market for [deodorants](#). Scientists are of course working to solve the odour problem; using for example, [ionic liquids that are applied to the skin](#) where they [emit pleasant smells when exposed to perspiration](#). Sweat may actually have redeeming qualities, such as [energy production](#)!

The [beauty industry](#) invests heavily in R&D, always in search of something that will set a company apart from its competition. One such innovation is [nail polish that detects incapacitating agents through a colour change \(a method to ensure no one has spiked your drink!\)](#); conceptually, this is similar to paint on [vehicles](#) (and [UAVs](#)) that changes colour when exposed to a chemical agent.

Personal care product R&D might also [help solve sanitation issues in the developing world](#), as demonstrated by [fragrance chemistry and latrines](#).

At the end of the day when [the personal care products on our bodies are removed](#), they still [end up somewhere](#). The [degradation of these products in waste treatment facilities](#) and their [environmental fate](#) can involve a series of complex mechanisms; calling for [large research initiatives](#) for assessment.



Cannabinoids

A growing number of [countries](#) are legalizing [marijuana for medical purposes](#) (see Figure 1), sparking increased interest in [cannabis-derived compounds \(cannabinoids\)](#) for [clinical use](#). Given that cannabinoids can be considered as a central nervous system (CNS) acting chemical, we take a look at chemistry and clinical reports related to cannabis.

Conditions for which therapeutic use have been considered include: [nausea and vomiting \(due to chemotherapy\)](#), [appetite stimulation for HIV/AIDS patients](#), [chronic pain](#), [spasticity](#), [depression](#), [anxiety](#), [sleep disorder](#), [psychosis](#), [glaucoma](#), and [Tourette syndrome](#). An analysis of published studies has yielded [mixed results for the quality of evidence supporting the benefits of medical marijuana](#). Never the less, other studies suggest there may be benefits from the use of cannabis (and/or cannabinoids) for conditions that include [pain modulation](#), especially in [combination with opioids](#); [inflammatory bowel disease](#); [reducing insulin-resistance in HIV-HCV infected patients](#); [Parkinson's Disease](#); [Alzheimer's Disease](#); and [pediatric treatment resistant epilepsy](#).

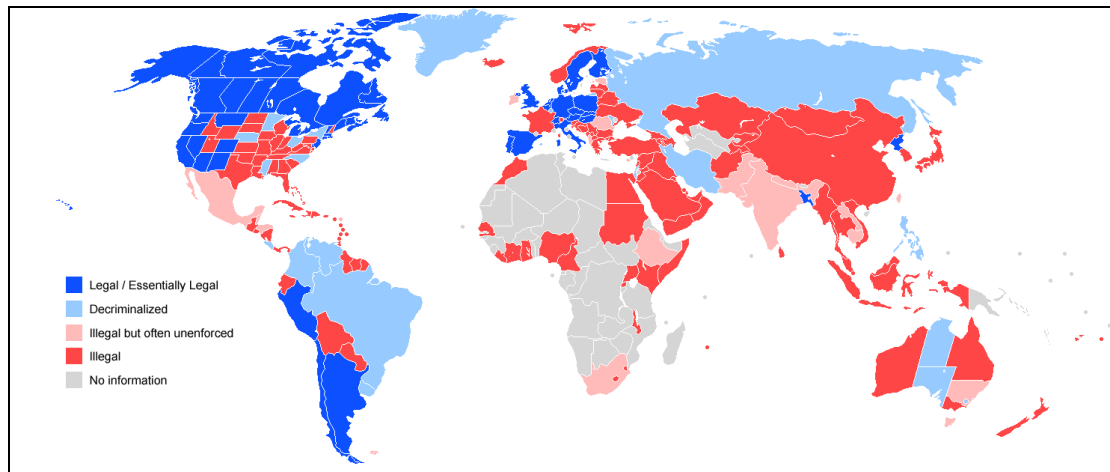


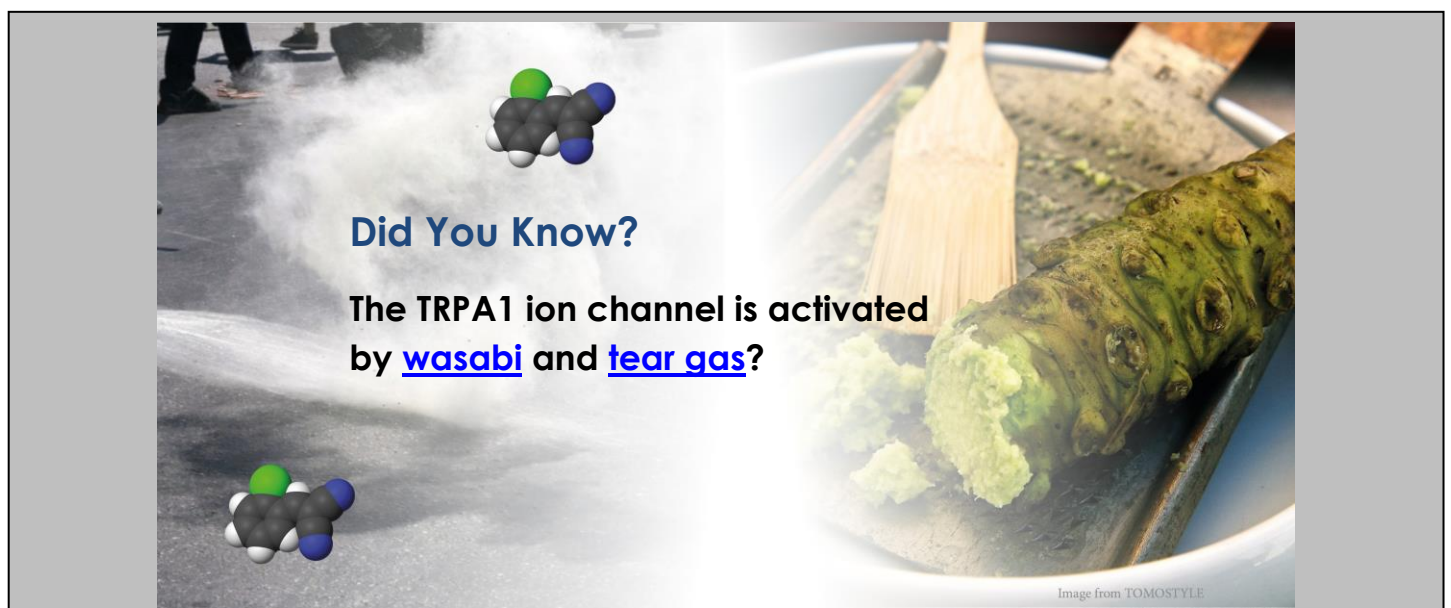
Figure 1: Status of Medical Marijuana as of 7 May 2014, Image courtesy of Trinitresque

There is also interest in the use of cannabinoids for chemotherapy, however, [no solid proof exists that cannabinoids would be effective in this application](#). Given studies that [cannot produce conclusive data](#), and concerns about unintended complications, [more clinical studies have been recommended](#).

As cannabis and cannabinoids become more available (whether for [medical](#) purposes or the recreational use of [marijuana](#) and/or [synthetic cannabinoids](#)), so does the potential for their misuse; for instance, [poison control centers in the United States reported a greater than 200% increase in the number of calls related to synthetic cannabinoid use for January - May 2015](#). Long-term effects, particularly in relation to [smoking](#) and [lung health](#), are also a concern.

With both a higher visibility and prevalence of use, issues related to [how to ensure legal marijuana is safe](#); [primary care](#) of users and [education for medical practitioners](#); [potency of the method of administration](#); combined effects [with alcohol](#) and [other drugs](#); and [fitness to drive](#) have received greater attention.

Not surprisingly, technology developers have also seized upon opportunities, such as the marketing of a [3D printable herb garden](#), resulting from all the interest in cannabis.



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