



OPCW

Organisation for the Prohibition of Chemical Weapons

The Chemical Universe: Scheduled and Unscheduled

*Science for Diplomats at EC-88
The Hague, 10 July 2018*

Cheng Tang,; 2019 SAB Chair Elect

Christopher Timperley, Ph.D.; SAB Chair

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Mr Joel De Saint Ours, Ms Siqing Sun, and Mr Vivek Suri
Support Staff, Office of Strategy and Policy

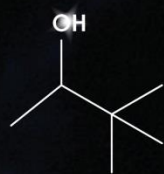
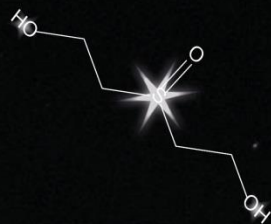
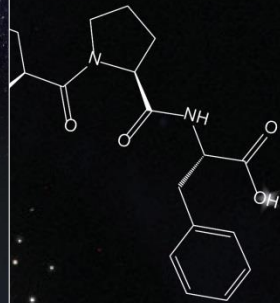
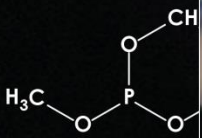
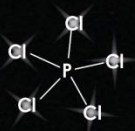
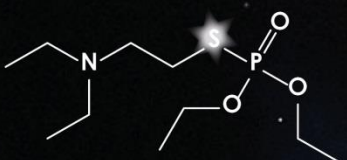
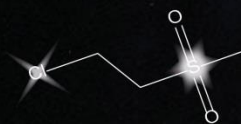
Explore the Chemical Universe

Scan



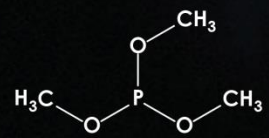
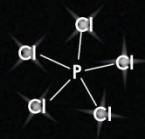
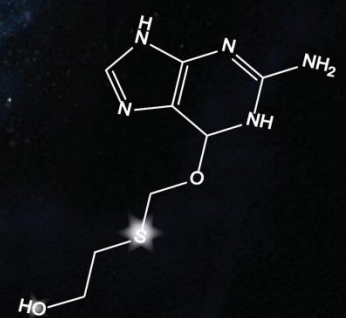
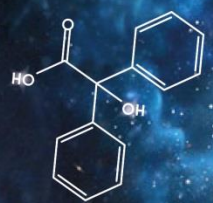
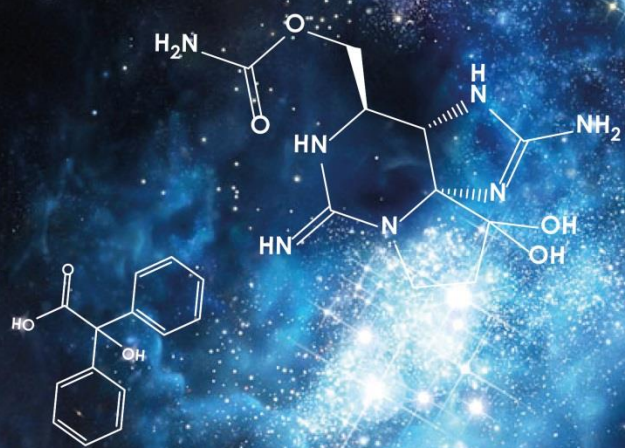
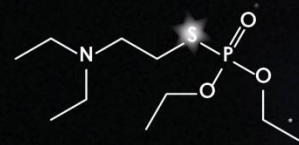
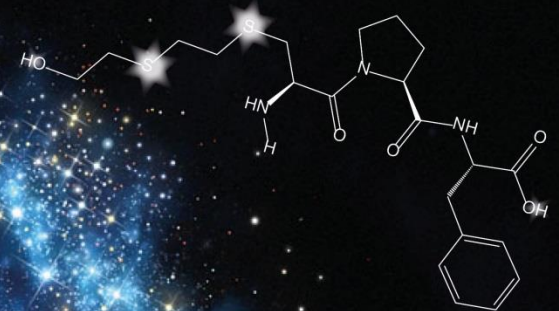
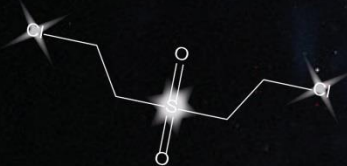
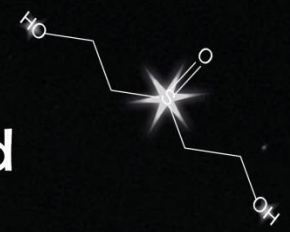
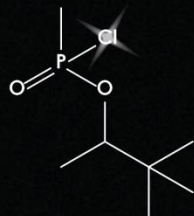
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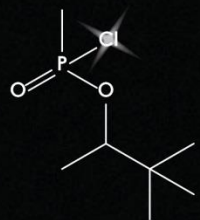


Science for Diplomats at EC-88

The Chemical Universe: Scheduled and Unscheduled

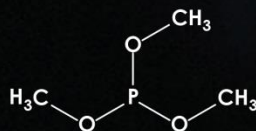
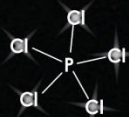
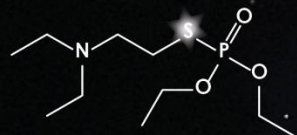
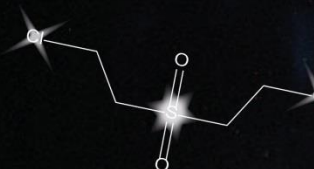


Tuesday, 10 July 2018
Ooms Room, OPCW
13:30 - 14:45
Light lunch served at 13:00



Science

The Chemical Universe



OPCW SciTech

@OPCW_ST

Join us at EC-88 for [#ScienceforDiplomats](#), a journey across the chemical universe & a look at the [@OPCW](#) Scientific Advisory Board [#CWCR4](#) recommendations on schedules.

翻译自英语

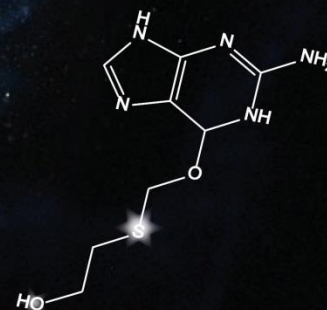
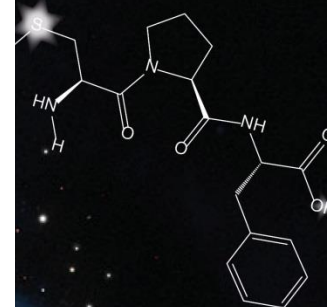
Science for Diplomats at EC-88
The Chemical Universe: Scheduled and Unscheduled

Tuesday, 10 July 2018
Ooms Room, OPCW
13:30 - 14:45
Light lunch served at 13:00

18年6月12日, 23:08

EC-88

Scheduled and Unscheduled





Scientific Advisory Board's Recommendations to the Fourth Review Conference of the Chemical Weapons Convention



A quick reference guide to the executive summary recommendations of the OPCW Scientific Advisory Board's report on developments in science and technology to the Fourth Review Conference (RC-4/DG.1, dated 30 April 2018).



Download RC-4/DG.1



OPCW

Review Conference

Fourth Session
21 – 30 November 2018

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

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

Introduction

1. The Scientific Advisory Board (SAB) was established by the Director-General in accordance with subparagraph 21(h) and paragraph 45 of Article VIII of the Chemical Weapons Convention (hereinafter “the Convention”), so that he could render to the Conference of the States Parties (hereinafter “the Conference”) and the Executive Council (hereinafter “the Council”) specialised advice in areas of science and technology relevant to the Convention. In keeping with this mandate, and as its contribution to the Fourth Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention (hereinafter “the Fourth Review Conference”), to be held from 21 to 30 November 2018, the SAB has prepared this report, which analyses relevant developments in science and technology over the past five years and presents recommendations and observations that the SAB considers to be important for the review of the operation of the Convention and its future implementation.
2. This report contains an executive summary and recommendations addressing issues that may impact the implementation of the Convention and the work of the Technical Secretariat (hereinafter “the Secretariat”). The analysis of developments in science and technology that informed the recommendations, as well as additional, more detailed recommendations, are provided in Annex 1.
3. This is the fourth report for a Review Conference by the SAB on developments in science and technology relevant to the Convention. The three earlier reports were presented to the First Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention¹ (hereinafter “the First Review Conference”), the Second Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention² (hereinafter “the Second Review Conference”), and the Third Special Session of the Conference

¹ RC-1/DG.2, dated 23 April 2003.
² RC-2/DG.1, dated 28 February 2008 and Corr.1, dated 5 March 2008.





OPCW SciTech
@OPCW_ST

Many thanks to delegations that joined us for today's discussion of the @OPCW Scientific Advisory Board's #CWCRC4 recommendations. #ScienceforDiplomats. Quick reference guide can be found here ow.ly/2Brl30kmSYc

翻译自英语



18年6月6日, 23:25

Science

Scientific Advisory Board to the Fourth Review Conference of the Chemical Weapons Convention



A quick reference guide to the executive summary of the OPCW Scientific Advisory Board's report on technology to the Fourth Review Conference of the Chemical Weapons Convention.

Review Conference

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

SCIENTIFIC ADVISORY BOARD REPORT ON TECHNOLOGY FOR THE FOURTH REVIEW CONFERENCE OF THE STATES PARTIES TO REVIEW THE CHEMICAL WEAPONS CONVENTION

The Board was established by the Director-General in his report in paragraph 45 of Article VIII of the Chemical Weapons Convention¹, so that he could render to the Conference the Executive's specialised advice in areas of science and technology. In keeping with this mandate, and as its first report, the Conference of the States Parties to the Chemical Weapons Convention (hereinafter "the Conference") on 21 to 30 November 2018, the SAB has provided its recommendations and observations that the SAB has made on the operation of the Convention and its

recommendations and observations that the SAB has made on the operation of the Convention and its

recommendations and observations that the SAB has made on the operation of the Convention and its

dated 5 March 2008.



Scheduled Chemicals under the Chemical Weapons Convention (CWC)

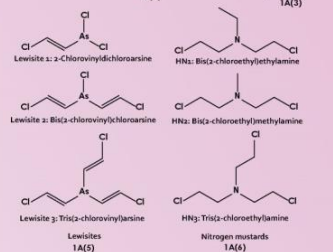
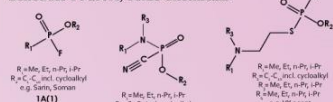
Schedule 1

Guidelines for Schedule 1

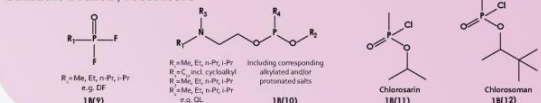
The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention by virtue of its high potential for use in activities prohibited under this Convention because one or more of the following conditions are met:
 - It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, comparable properties;
 - It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon;
 - It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;
- It has little or no use for purposes not prohibited under this Convention.

Schedule 1 Part A, Toxic Chemicals



Schedule 1 Part B, Precursors



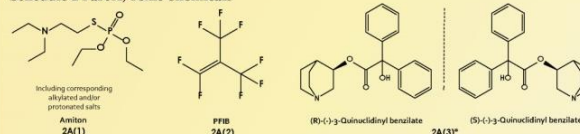
Schedule 2

Guidelines for Schedule 2

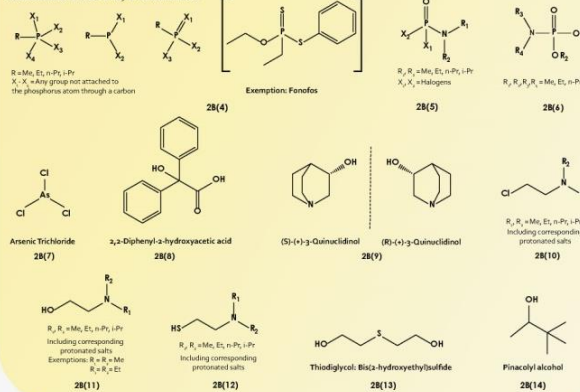
The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:

- It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
- It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2, part A;
- It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A;
- It is not produced in large commercial quantities for purposes not prohibited under this Convention.

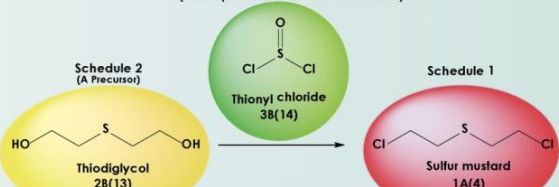
Schedule 2 Part A, Toxic Chemicals



Schedule 2 Part B, Precursors



Schedule 3 (Used in production of Schedule 1 chemicals)



Relationship between Schedules, illustrated with sulfur mustard.

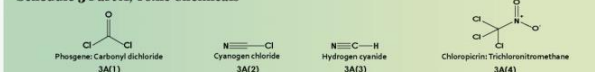
Schedule 3

Guidelines for Schedule 3

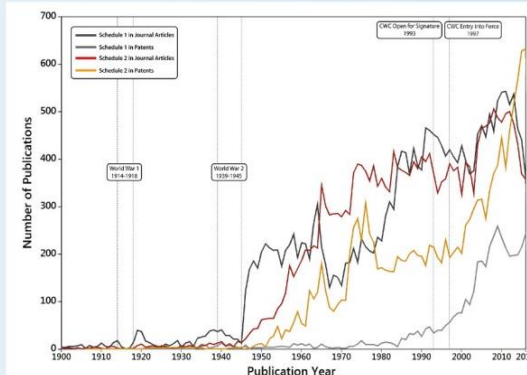
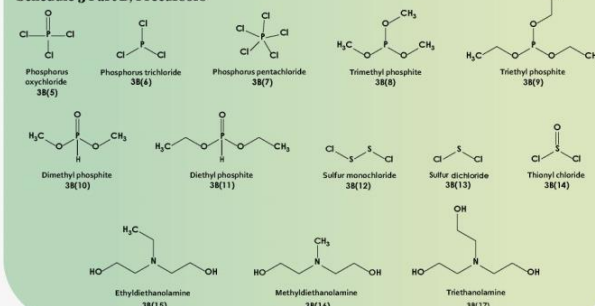
The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- It has been produced, stockpiled or used as a chemical weapon;
- It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that might enable it to be used as a chemical weapon;
- It poses a risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part B;
- It may be produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 3 Part A, Toxic Chemicals



Schedule 3 Part B, Precursors



Scheduled chemicals, including those in schedules 1 and 2, can have scientifically and economically important uses. This chart captures the number of yearly scientific publications that refer to them.



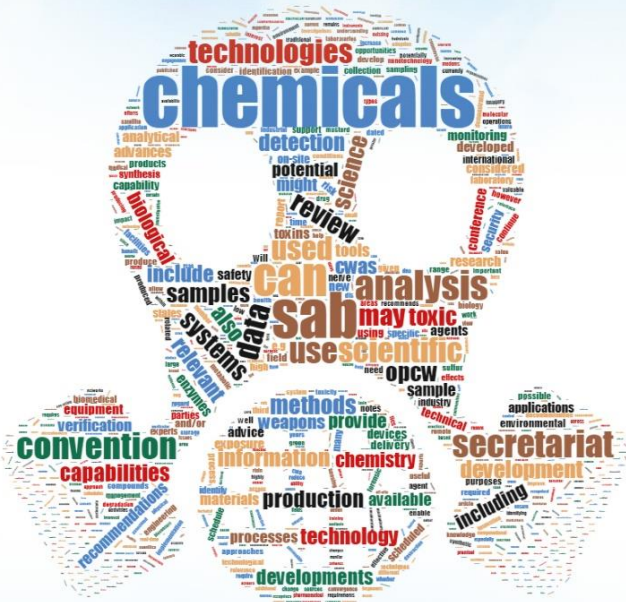
ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Working Together for a World Free of Chemical Weapons



Scheduled Chemicals under the Chemical Weapons Convention (CWC)

Scientific Advisory Board's Recommendations to the Fourth Review Conference of the Chemical Weapons Convention



A quick reference guide to the executive summary recommendations of the OPCW Scientific Advisory Board's report on developments in science and technology to the Fource Review Conference (RC-4/DG.1, dated 30 April 2018).



Download RC-4/DG.1

ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS
Working Together for a World Free of Chemical Weapons

Schedule 2

Schedule 2
be taken into account in considering whether a toxic Schedule 1 or a precursor to a Schedule 1 chemical or to a Schedule 2, part A, should be included in Schedule 2:
ask to the object and purpose of this Convention because

“Given the substantial changes in chemistry and chemical industry since the schedules were finalised a quarter century ago, a review of the schedules should be considered to assess whether: (a) the chemicals currently listed are in the appropriate Schedule, and (b) any toxic chemicals or specific precursors should be added to or removed from the Schedules.”

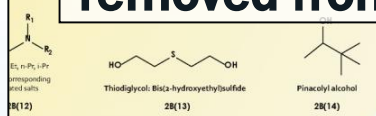
Schedule 3

Guidelines for Schedule 3

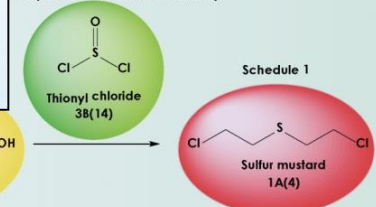
The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

(a) It has been produced, stockpiled or used as a chemical weapon;

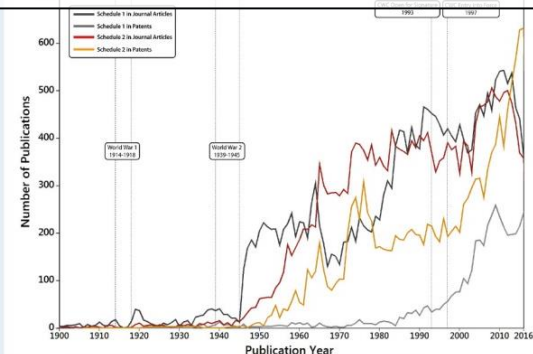
(b) It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that are of such importance in the production of one or more chemicals listed in Schedule 3 that the production, stockpiling or use of such chemical or precursor is prohibited under this Convention.



Schedule 3
used in production of Schedule 1 chemicals)



Relationship between Schedules, illustrated with sulfur mustard.



Scheduled chemicals, including those in schedules 1 and 2, can have scientifically and economically important uses. This chart captures the number of yearly scientific publications that refer to them.

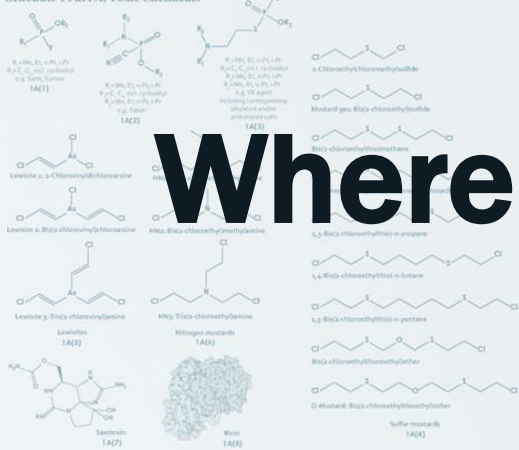
Review the Schedules?

Guidelines for Schedule 1

The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- (a) It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;
- (b) It poses otherwise a high risk to the object and purpose of this Convention by virtue of its high potential for use in activities prohibited under this Convention because one or more of the following conditions are met:
 - (i) It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, comparable properties;
 - (ii) It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon;
 - (iii) It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;
- (c) It has little or no use for purposes not prohibited under this Convention.

Schedule 1 Part A, Toxic Chemicals



Schedule 1 Part B, Precursors

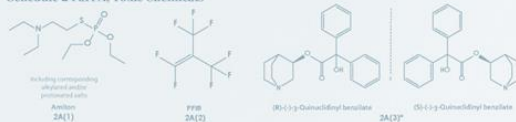


Guidelines for Schedule 2

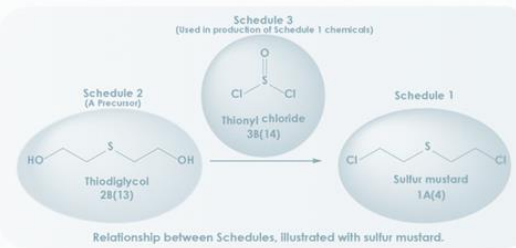
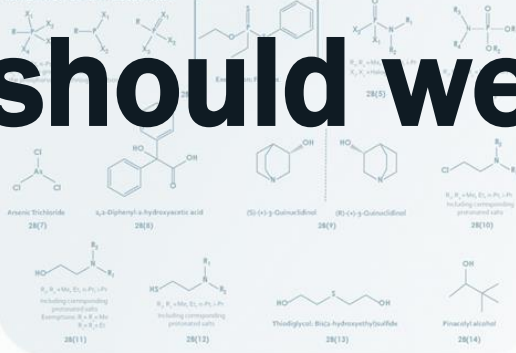
The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:

- (a) It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
- (b) It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2, part A;
- (c) It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A;
- (d) It is not produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 2 Part A, Toxic Chemicals



Schedule 2 Part B, Precursors



Guidelines for Schedule 3

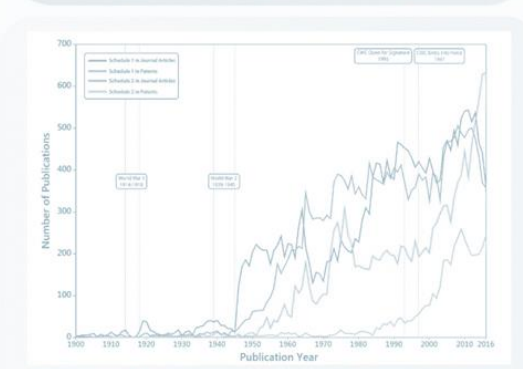
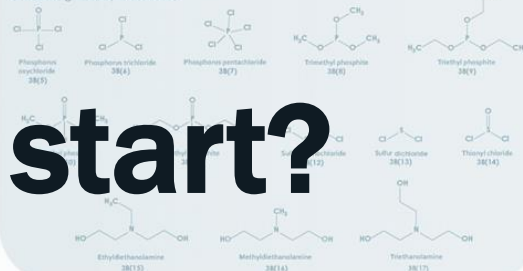
The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- (a) It has been produced, stockpiled or used as a chemical weapon;
- (b) It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that might enable it to be used as a chemical weapon;
- (c) It poses a risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part B;
- (d) It may be produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 3 Part A, Toxic Chemicals



Schedule 3 Part B, Precursors



Scheduled chemicals, including those in schedules 1 and 2, can have scientifically and economically important uses. This chart captures the number of yearly scientific publications that refer to them.



ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Working Together for a World Free of Chemical Weapons



OPCW

Lets Start with a Quiz!



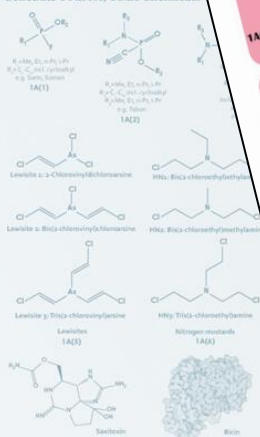
How Well Do You Know Your Schedules?

Guidelines for Schedule 1

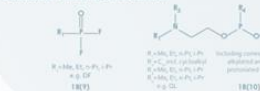
The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- (a) It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;
- (b) It poses otherwise a high risk to the object and purpose of this Convention because of its high potential for use as a chemical weapon;
- (i) It possesses chemical properties that are comparable to those of chemicals listed in Schedule 1;
- (ii) It possesses other properties that are comparable to those of chemicals listed in Schedule 1;
- (iii) It may be used for the production of one or more of the chemicals listed in Schedule 1 in quantities that are not negligible for the purposes of this Convention;
- (c) It has little or no use for other purposes than those mentioned in (a), (b) and (c).

Schedule 1 Part A, Toxic Chemicals



Schedule 1 Part B, Precursors



Guidelines for Schedule 2

The following criteria shall be taken into account in considering whether a toxic chemical or precursor to a Schedule 1 chemical should be included in Schedule 2:

- (a) It poses otherwise a high risk to the object and purpose of this Convention because of its high potential for use as a chemical weapon;
- (i) It possesses chemical properties that are comparable to those of chemicals listed in Schedule 1;
- (ii) It possesses other properties that are comparable to those of chemicals listed in Schedule 1;
- (iii) It may be used for the production of one or more of the chemicals listed in Schedule 1 in quantities that are not negligible for the purposes of this Convention;
- (c) It has little or no use for other purposes than those mentioned in (a), (b) and (c).

Schedule 2 Chemicals

Guidelines for Schedule 2

The following criteria shall be taken into account in considering whether a toxic chemical or precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:

- a. It poses a significant risk to the object and purpose of this Convention because of its high potential for use as a chemical weapon;
- b. It may be used as a precursor in one of the chemical or biochemical processes listed in Schedule 1 or Schedule 2, part A, in quantities that are not negligible for the purposes of this Convention;
- c. It poses otherwise a high risk to the object and purpose of this Convention because of its high potential for use as a chemical weapon;
- d. It is not produced in large commercial quantities for other purposes than those mentioned in (a), (b) and (c).

2A(1) : Amiton
O,O-Diethyl S-(2-(diethylaminoethyl) phosphorothioate and corresponding alkylated or protonated salts

2A(2) : BZ
S-(1-3-Quinoxaliny) benzilate

2B(4)
Chemicals, except for those listed in Schedule 1, in which it bonded one methyl, vinyl and/or butyl but not further carbon atoms.
(Example: Fosfon + O-Ethyl S-phenyl ethylphosphoramidate)

2B(5)
N,N-Dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidic chlorides

2B(7)
Aromatic trichlorides

2B(8)
2,2-Diphosphor-2

Guidelines for Schedule 3

The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- (a) It has been produced, stockpiled or used as a chemical weapon;
- (b) It poses otherwise a high risk to the object and purpose of this Convention because of its high potential for use as a chemical weapon;
- (i) It possesses chemical properties that are comparable to those of chemicals listed in Schedule 1 or Schedule 2;
- (ii) It possesses other properties that are comparable to those of chemicals listed in Schedule 1 or Schedule 2;
- (iii) It may be used for the production of one or more of the chemicals listed in Schedule 1 or Schedule 2 in quantities that are not negligible for the purposes of this Convention;
- (c) It has little or no use for other purposes than those mentioned in (a), (b) and (c).

Schedule 3 Chemicals

Guidelines for Schedule 3

The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- a. It has been produced, stockpiled or used as a chemical weapon;
- b. It poses otherwise a high risk to the object and purpose of this Convention because of its high potential for use as a chemical weapon;
- c. It possesses chemical properties that are comparable to those of chemicals listed in Schedule 1 or Schedule 2;
- d. It possesses other properties that are comparable to those of chemicals listed in Schedule 1 or Schedule 2;
- e. It may be used for the production of one or more of the chemicals listed in Schedule 1 or Schedule 2 in quantities that are not negligible for the purposes of this Convention;
- f. It has little or no use for other purposes than those mentioned in (a), (b) and (c).

3A(1) : Phosgene
Carbon tetrachloride

3A(2)
Cyanogen chloride

3A(3)
Hydrogen cyanide

3A(4) : Chloropicrin
Trichloromethane

3B(1)
Diethyl phosphite

3B(2)
Phosphorus trichloride

3B(3)
Phosphorus pentachloride

3B(4)
Triethyl phosphite

3B(5)
Dimethyl phosphite

3B(6)
Diethyl phosphite

3B(7)
Diethyl phosphite

3B(8)
Diethyl phosphite

3B(9)
Triethyl phosphite

3B(10)
Diethyl phosphite

3B(11)
Diethyl phosphite

3B(12)
Sulfur dibromide

3B(13)
Sulfur dibromide

3B(14)
Thionyl chloride

3B(15)
Ethylthionocarbamate

3B(16)
Methylthionocarbamate

3B(17)
Triethylthionocarbamate

Instructions

"Test your schedule knowledge"

Place the molecule in the correct schedule

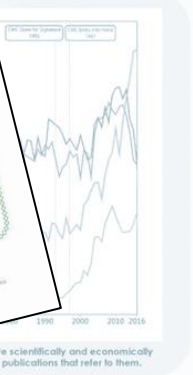
You can check the answer by scanning QR codes with the Augment app. Download here.

AUGMENT

QR codes for Augment app



Download at: <https://www.opcw.org/special-sections/science-technology/science-for-diplomats/>







Figures 1 and 2 can have scientifically and economically important implications for the number of yearly scientific publications that refer to them.










How Well Do You Know Your Schedules?

Instructions




“Test your schedule knowledge”
Place the molecule on the correct schedule

Single bond:  3.5 cm
 Double bond:  3 cm
 Triple bond:  2.5 cm
 Bond to H:  2 cm


For molecular models:



C*:		H:		S:	
N:		P*:		As*:	
Cl:		F:		O:	



* in Augment app:

C:		P:		As:	
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You can check the answers by scanning QR codes with the Augment app. Download here:



Guidelines for Schedule 3


The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- It has been produced, stockpiled or used as a chemical weapon;
- It poses otherwise a risk to the object and purpose of this Convention because of its toxicity as well as other properties that make it suitable for use as a chemical weapon;
- Its production for purposes of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part B, is prohibited under this Convention;
- It may be produced in large commercial quantities for purposes not otherwise prohibited under this Convention.


Chemicals

Schedule 3


3A(3)
Hydrogen cyanide




3A(4): Chloropicrin
Trichloroacetone

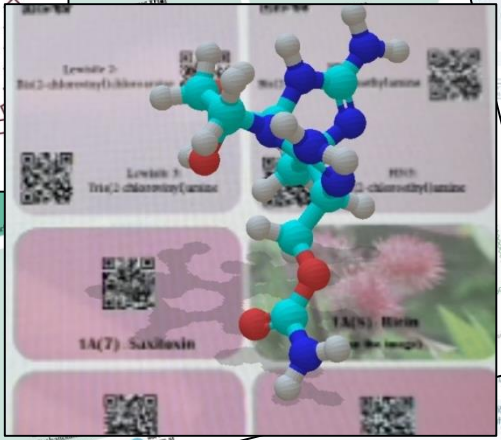


3B(7)
Phosphorus pentachloride



3B(8)
Trimethyl phosphite





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OPCW

Match the molecules to the Schedule
Prizes for whomever gets the most correct!

Scheduled Chemicals under the Chemical Weapons Convention (CWC)

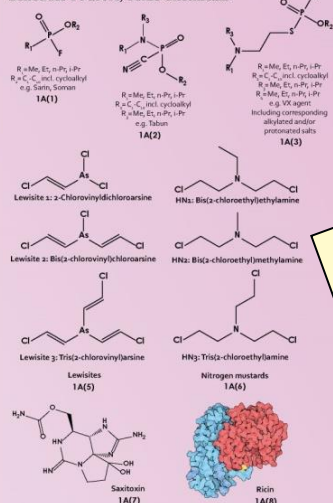
Schedule 1

Guidelines for Schedule 1

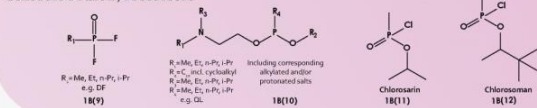
The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article I;
- It poses otherwise a high risk to the object and purpose of this Convention by virtue of its high potential for use in activities prohibited under this Convention because one or more of the following conditions are met:
 - It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, comparable properties;
 - It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon;
 - It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;
- It has little or no use for purposes not prohibited under this Convention.

Schedule 1 Part A, Toxic Chemicals



Schedule 1 Part B, Precursors



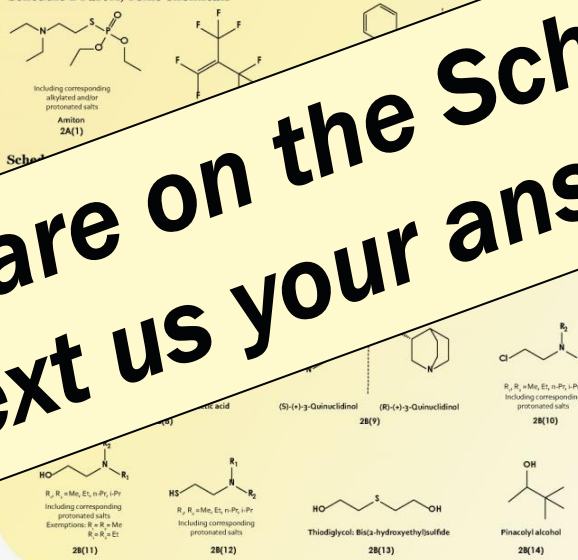
Schedule 2

Guidelines for Schedule 2

The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:

- It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
- It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2, part A;
- It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A;
- It is not produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 2 Part A, Toxic Chemicals

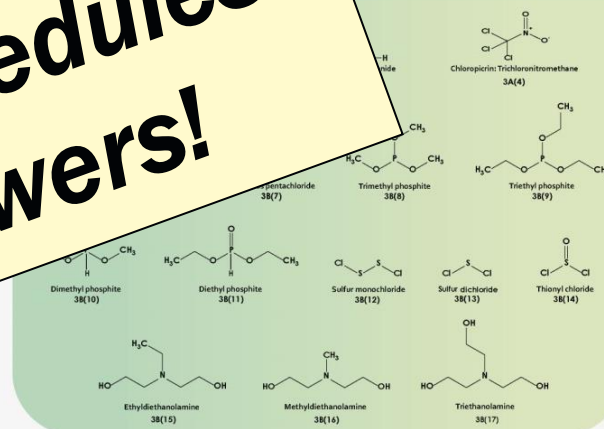


Schedule 3

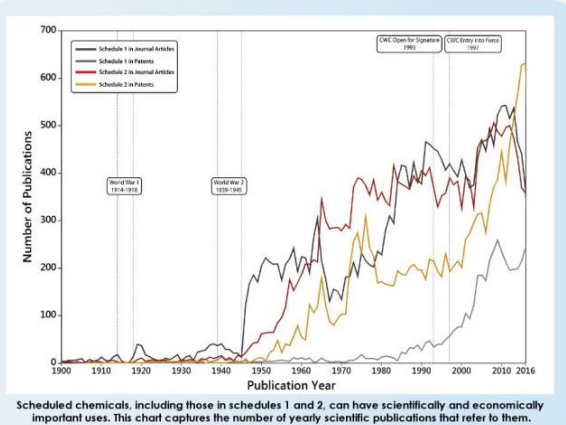
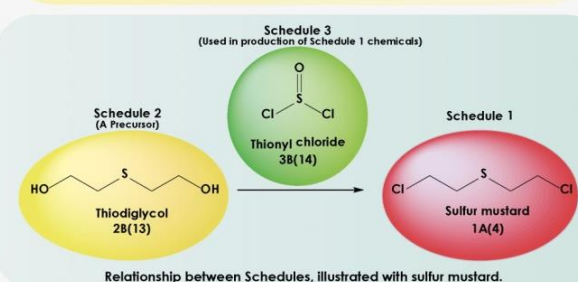
Guidelines for Schedule 3

The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- It has been produced, stockpiled or used as a chemical weapon;
- It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that might enable it to be used as a chemical weapon;
- It poses a risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part A, in large commercial quantities for purposes not prohibited under this Convention.



What are on the Schedules?
Text us your answers!



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Schedule 1

Guidelines for Schedule 1

The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- (a) It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;

Schedule 2

Guidelines for Schedule 2

This list is intended to be taken into account in considering whether a toxic chemical listed in Schedule 2, part A, should be included in Schedule 2:

- (a) It poses a significant risk to the object and purpose of this Convention because

Schedule 3

Guidelines

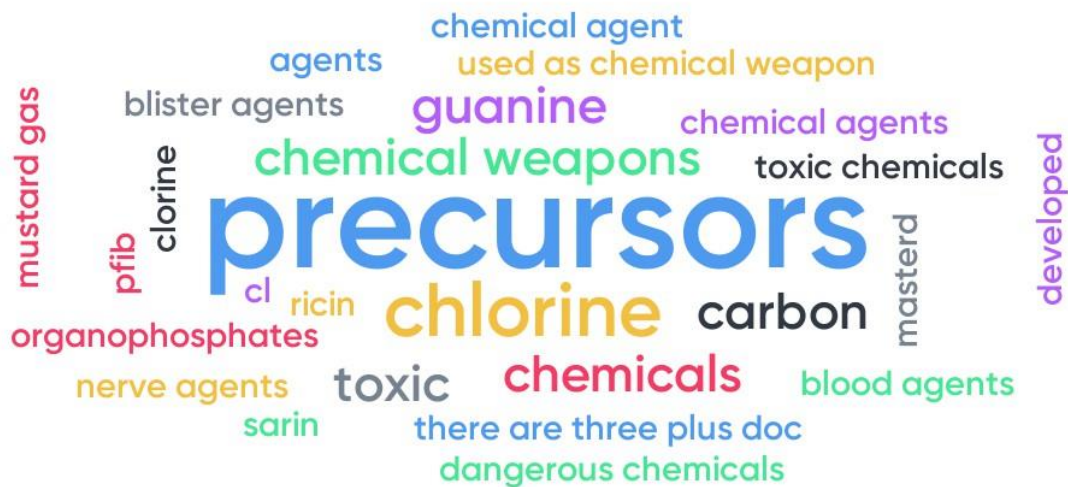
This list is intended to be taken into account in considering whether a toxic chemical listed in Schedule 3, part A, should be included in Schedule 3:

- (a) It has been produced, stockpiled or used as a chemical weapon;

Answers from the Audience

What Do the Schedules Contain?

Mentimeter



22



Scheduled Chemicals under the Chemical Weapons Convention (CWC)

Schedule 1

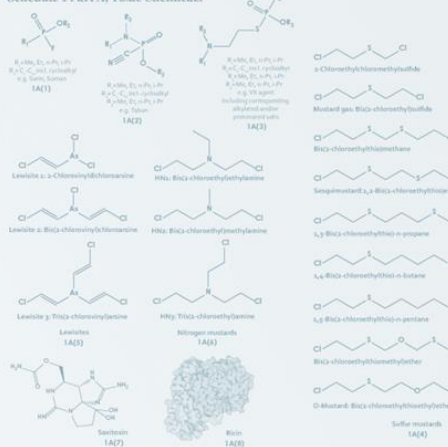
Schedule 1

Guidelines for Schedule 1

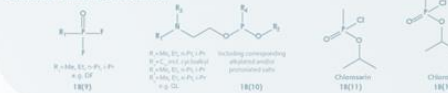
The following criteria shall be taken into account in considering whether a chemical or precursor should be included in Schedule 1:

- It has been developed, produced, stockpiled or used as a chemical weapon defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention because of its high potential for use in activities prohibited by this Convention because one or more of the following conditions are met:
 - It possesses a chemical structure closely related to that of a chemical listed in Schedule 1, and has, or can be expected to have, comparable properties;
 - It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon because it may be used as a precursor in the final single technological production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;
 - It has little or no use for purposes not prohibited under this Convention.

Schedule 1 Part A, Toxic Chemicals

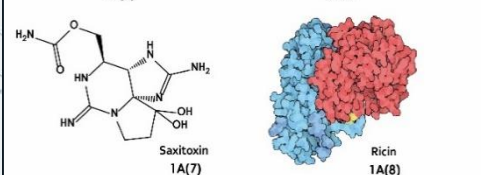
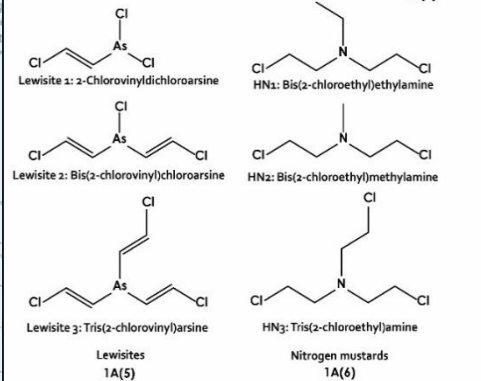
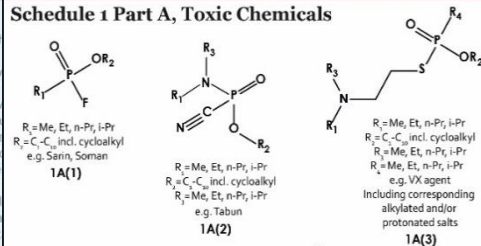


Schedule 1 Part B, Precursors

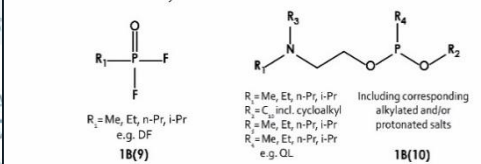


Schedule 1

Schedule 1 Part A, Toxic Chemicals



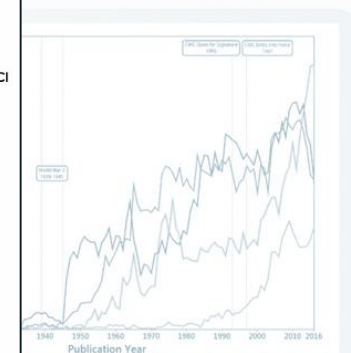
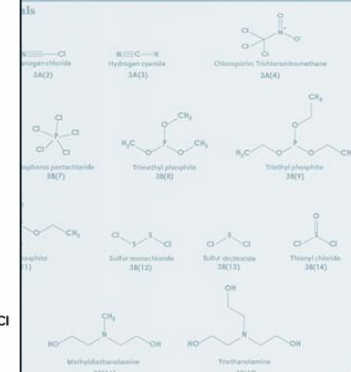
Schedule 1 Part B, Precursors



Schedule 3

The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 3:

- It has been developed, produced, stockpiled or used as a chemical weapon defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention because of its high potential for use in activities prohibited by this Convention because one or more of the following conditions are met:
 - It possesses a chemical structure closely related to that of a chemical listed in Schedule 3, and has, or can be expected to have, comparable properties;
 - It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon because it may be used as a precursor in the final single technological production of a toxic chemical listed in Schedule 3, regardless of whether this stage takes place in facilities, in munitions or elsewhere;
 - It has little or no use for purposes not prohibited under this Convention.



The number of scientific publications referring to chemicals in Schedules 1 and 2 has increased significantly since 1980, and is expected to continue to rise as the number of yearly scientific publications that refer to them.



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OPCW

Scheduled Chemicals under the Chemical Weapons Convention (CWC)

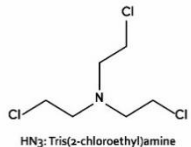
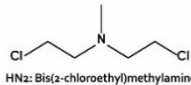
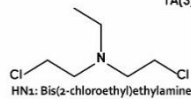
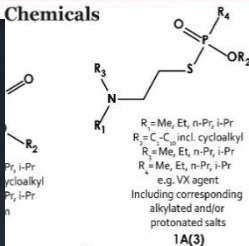
Schedule 1

Schedule 1

Schedule 1

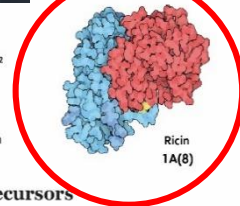
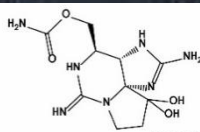
Schedule 3

Schedule 1 Part A, Toxic Chemicals

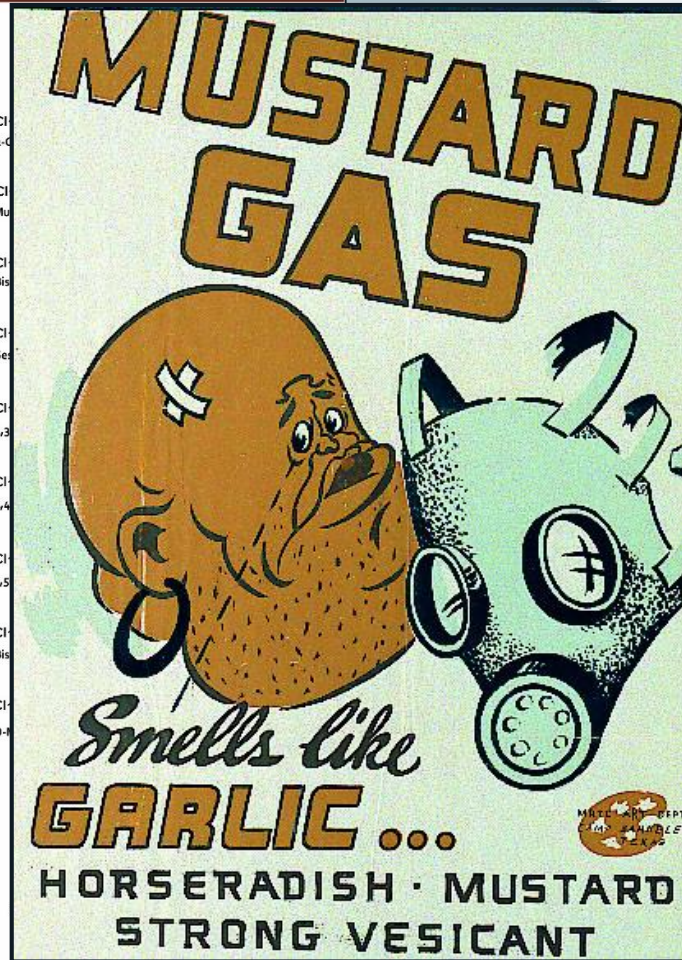
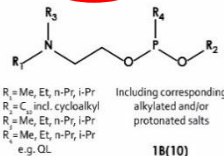
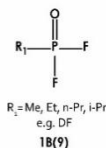


Nitrogen mustards

1A(6)



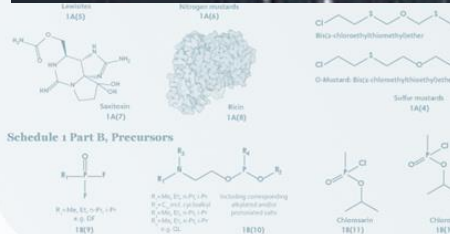
Schedule 1 Part B, Precursors



Chlorosarin
1B(11)

Chlorosoman
1B(12)

Publication Year
use in schedules 1 and 2, can have scientifically and economically as the number of yearly scientific publications that refer to them.



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OPCW

Scheduled Chemicals under the Chemical Weapons Convention (CWC)

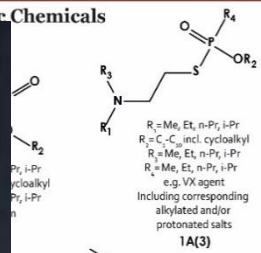
Schedule 1

Schedule 1

Schedule 1

Schedule 3

Schedule 1 Part A, Toxic Chemicals



Placement of RSS bar code to read as UPC number

67386 911 51

DANGER: Contact Poison. Avoid contact with skin, mucous membranes, or eyes. Do not inhale the dust or vapor. In case of skin contact, wash with copious amounts of water for at least 15 minutes, followed by 2% sodium thiosulfate solution. See PRECAUTION and DOSAGE AND ADMINISTRATION in accompanying package insert. Store at controlled room temperature, 15-30°C (59-86°F). Protect from light and humidity.

NDC 67386-911-51 **1 Vial**

Trituration of Mustargen®
(mechlorethamine HCl for injection)

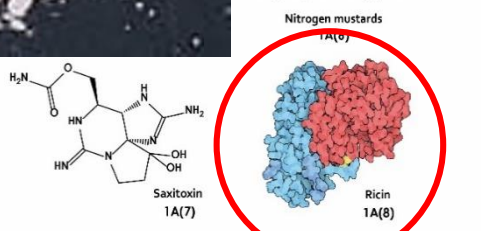
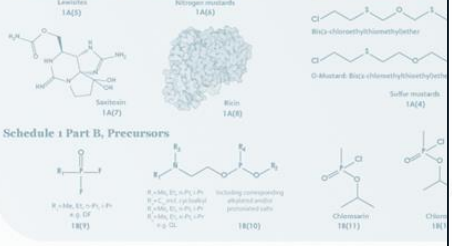
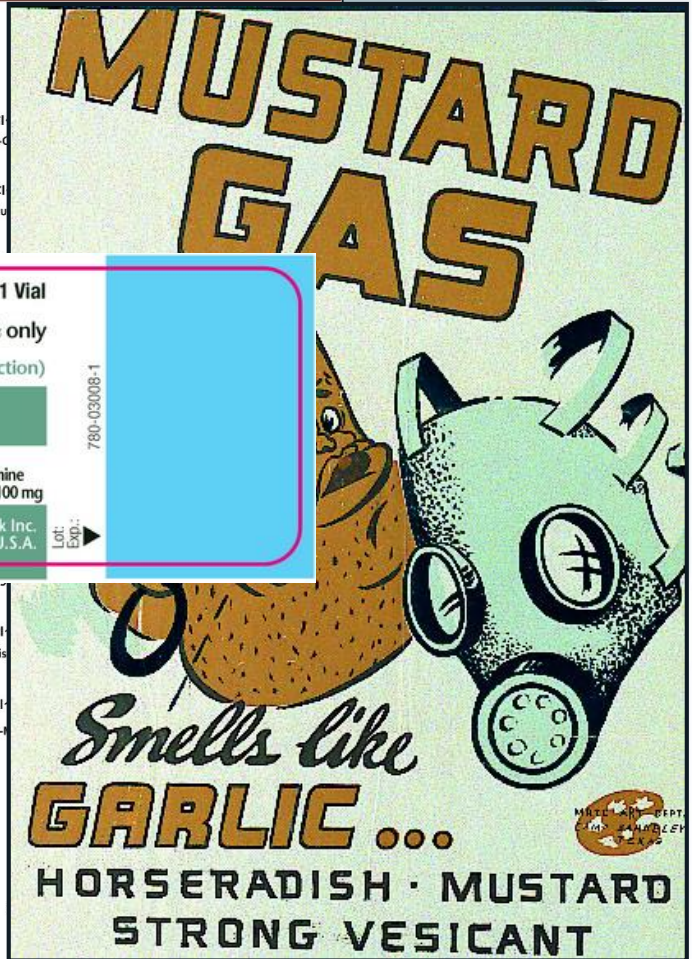
10 mg **Rx only**

A Nitrogen Mustard – POISON
This vial contains 10 mg of mechlorethamine hydrochloride with sodium chloride q.s. 100 mg

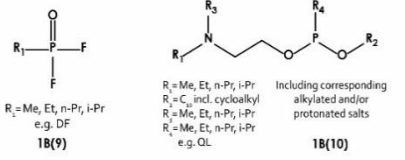
Lundbeck Inc.
Deerfield, IL 60015, U.S.A.

Lot: EXP: ▶

780-03008-1



Schedule 1 Part B, Precursors



Chlorosarin 1B(11)	Chlorosoman 1B(12)	Publication Year use in schedules 1 and 2, can have scientifically and economically as the number of yearly scientific publications that refer to them.
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Scheduled Chemicals under the Chemical Weapons Convention (CWC)

Schedule 2

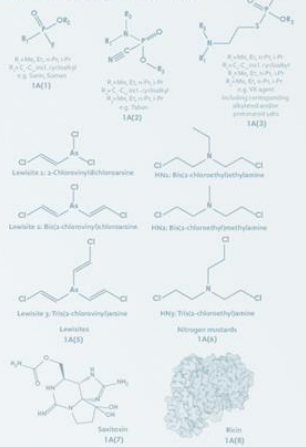
Schedule 1

Guidelines for Schedule 1

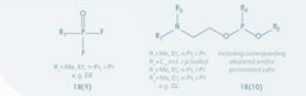
The following criteria shall be taken into account when considering whether a chemical or precursor should be included in Schedule 1:

- It has been developed, produced, stockpiled or used for purposes not prohibited by this Convention as defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention because of its high potential for use as a chemical weapon because one or more of the following criteria are met:
 - It possesses a chemical structure closely related to that of the chemicals listed in Schedule 1, and comparable properties;
 - It possesses such lethal or incapacitating properties that would enable it to be used as a precursor in the production of a toxic chemical listed in Schedule 1 whether this stage takes place in fact or in potential;
 - It has little or no use for purposes not prohibited by this Convention.

Schedule 1 Part A, Toxic Chemicals



Schedule 1 Part B, Precursors

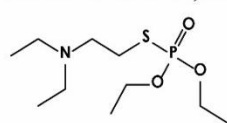


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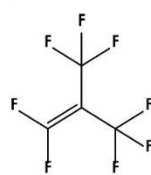
Schedule 2

Schedule 2 Part A, Toxic Chemicals

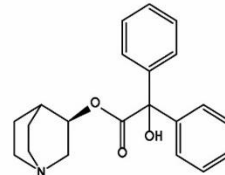


Including corresponding alkylated and/or protonated salts

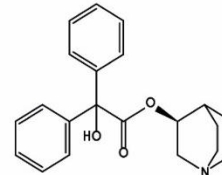
Amiton
2A(1)



PFIB
2A(2)

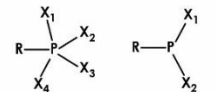


(R)-(-)-3-Quinuclidinyl benzilate
2A(3)*

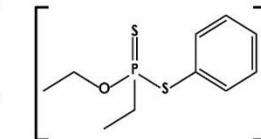


(S)-(+)-3-Quinuclidinyl benzilate

Schedule 2 Part B, Precursors

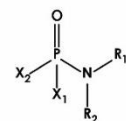


R = Me, Et, n-Pr, i-Pr
X₁, X₂ = Any group not attached to the phosphorus atom through a carbon



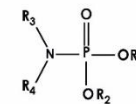
Exemption: Fonofos

2B(4)



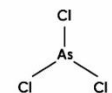
R₁, R₂ = Me, Et, n-Pr, i-Pr
X₁, X₂ = Halogens

2B(5)

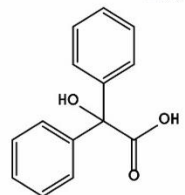


R₁, R₂, R₃, R₄ = Me, Et, n-Pr, i-Pr

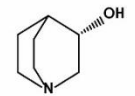
2B(6)



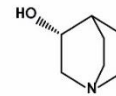
Arsenic Trichloride
2B(7)



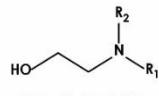
2,2-Diphenyl-2-hydroxyacetic acid
2B(8)



(S)-(+)-3-Quinuclidinol
2B(9)

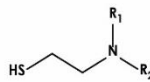


(R)-(+)-3-Quinuclidinol
2B(9)



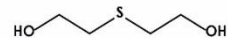
R₁, R₂ = Me, Et, n-Pr, i-Pr
Including corresponding protonated salts
Exemptions: R₁ = R₂ = Me
R₁ = R₂ = Et

2B(11)

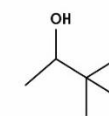


R₁, R₂ = Me, Et, n-Pr, i-Pr
Including corresponding protonated salts

2B(12)



Thiodiglycol: Bis(2-hydroxyethyl)sulfide
2B(13)



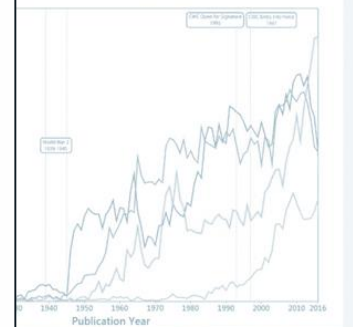
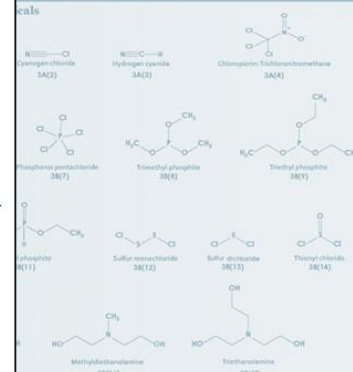
Pinacolyl alcohol
2B(14)

Schedule 3

The following criteria shall be taken into account when considering whether a toxic chemical listed in other Schedules, should be included in Schedule 3:

- It is stockpiled or used as a chemical weapon;
- It poses otherwise a high risk to the object and purpose of this Convention because of its high potential for use as a chemical weapon because one or more of the following criteria are met:
 - It possesses a chemical structure closely related to that of the chemicals listed in Schedule 1, and comparable properties;
 - It possesses such lethal or incapacitating properties that would enable it to be used as a precursor in the production of a toxic chemical listed in Schedule 1 whether this stage takes place in fact or in potential;
 - It has little or no use for purposes not prohibited by this Convention.

The following criteria shall be taken into account when considering whether a toxic chemical listed in other Schedules, should be included in Schedule 3:



Chemicals in Schedules 1 and 2 can have scientifically and economically increased the number of yearly scientific publications that refer to them.



OPCW

Scheduled Chemicals under the Chemical Weapons Convention (CWC)

Schedule 2

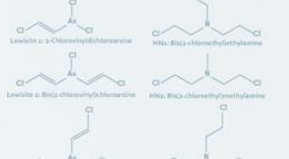
Schedule 1

Guidelines for Schedule 1

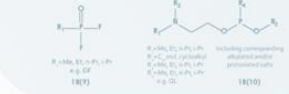
The following criteria shall be taken into account when considering whether a chemical or precursor should be included in Schedule 1:

- It has been developed, produced, stockpiled or used for purposes not prohibited by this Convention as defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention because of its high potential for use as a chemical weapon because one or more of the following criteria are met:
 - It possesses a chemical structure closely related to that of a chemical listed in Schedule 1, and comparable properties;
 - It possesses such lethal or incapacitating properties that would enable it to be used as a precursor in the production of a toxic chemical listed in Schedule 1 whether this stage takes place in full or in part;
 - It has little or no use for purposes not prohibited by this Convention.

Schedule 1 Part A, Toxic Chemicals

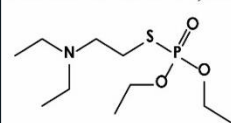


Schedule 1 Part B, Precursors

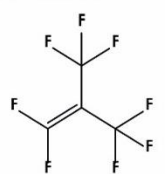


Schedule 2

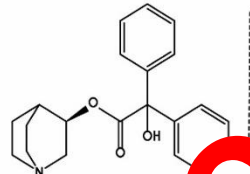
Schedule 2 Part A, Toxic Chemicals



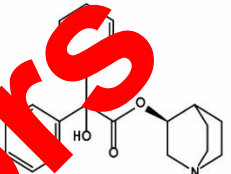
Including corresponding alkylated and/or protonated salts
Amitriptyline 2A(1)



PFIB 2A(2)

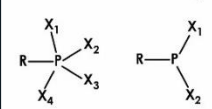


(R)-(-)-3-Quinuclidinyl benzilate 2A(3)

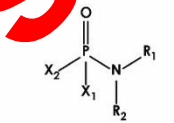
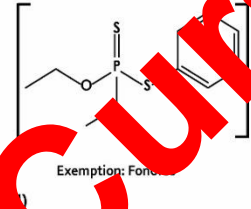


(S)-(-)-3-Quinuclidinyl benzilate 2A(4)

Schedule 2 Part B, Precursors

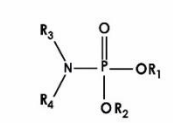


R = Me, Et, n-Pr, i-Pr
X₁-X₄ = Any group not attached to the phosphorus atom through a carbon



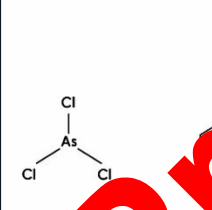
R₁, R₂ = Me, Et, n-Pr, i-Pr
X₁, X₂ = Halogens

2B(5)

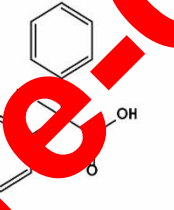


R₁, R₂, R₃, R₄ = Me, Et, n-Pr, i-Pr

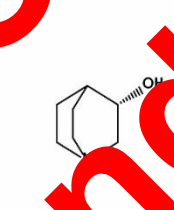
2B(6)



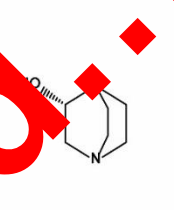
Arsenic Trichloride 2B(7)



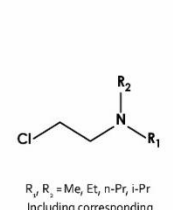
2,2-Diphenyl-2-hydroxyacetic acid 2B(8)



(S)-(+)-3-Quinuclidinol 2B(9)

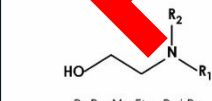


(R)-(+)-3-Quinuclidinol 2B(10)



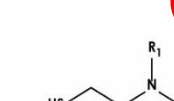
R₁, R₂ = Me, Et, n-Pr, i-Pr
Including corresponding protonated salts

2B(11)



R₁, R₂ = Me, Et, n-Pr, i-Pr
Including corresponding protonated salts
Exemptions: R₁ = R₂ = Me
R₁ = R₂ = Et

2B(12)



R₁, R₂ = Me, Et, n-Pr, i-Pr
Including corresponding protonated salts

2B(13)



Thiodiglycol: Bis(2-hydroxyethyl)sulfide 2B(14)



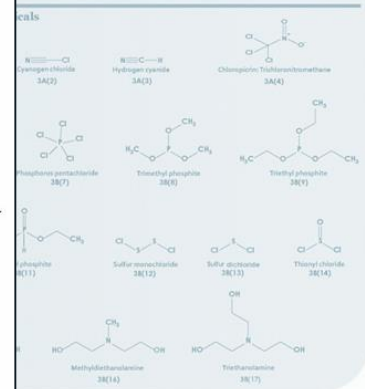
Pinacolyl alcohol 2B(15)

Schedule 3

Schedule 3 chemicals shall be taken into account in considering whether a toxic chemical listed in other Schedules, should be included in Schedule 1.

Schedule 3 chemicals shall be taken into account in considering whether a toxic chemical listed in other Schedules, should be included in Schedule 1.

Schedule 3 chemicals shall be taken into account in considering whether a toxic chemical listed in other Schedules, should be included in Schedule 1.



Chemicals listed in Schedules 1 and 2 can have scientifically and economically important uses. The number of yearly scientific publications that refer to them is shown in the graph above.

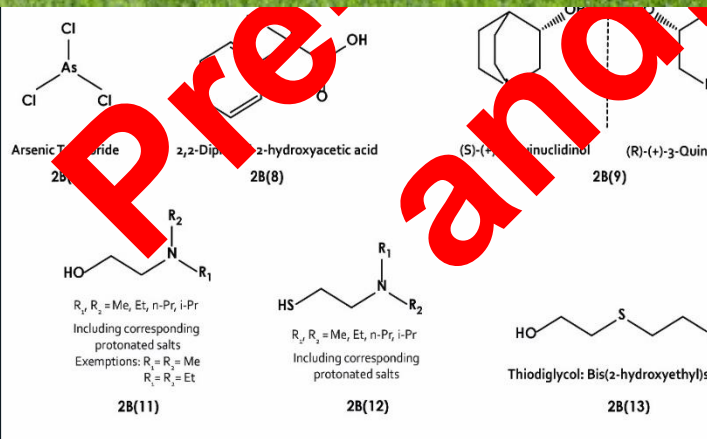
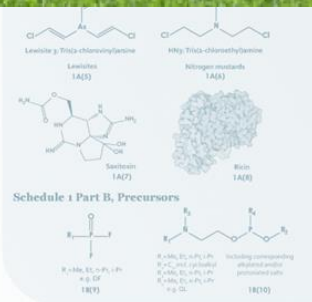


Schedule 2

Fire Retardants



Organophosphorus pesticides



ORGANISATION FOR PROHIBITION OF CHEMICAL WEAPONS
Working Together for a World without Chemical Weapons



Chemicals in schedules 1 and 2 can have scientifically and economically viable alternatives. The number of yearly scientific publications that refer to them.



Schedule 2

Fire Retardants



es



Pharmaceutical Pre-Cursors

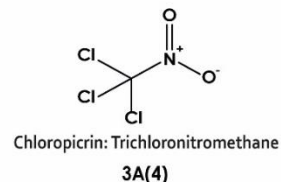
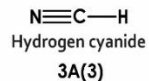
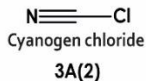
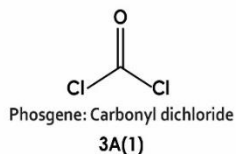


OPCW

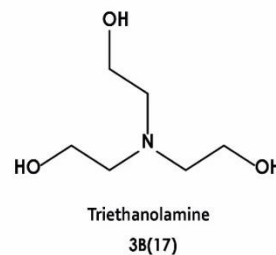
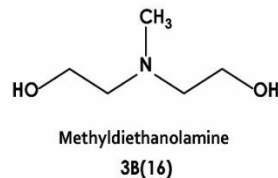
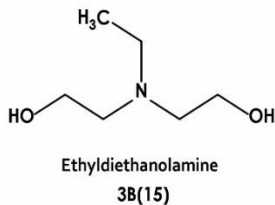
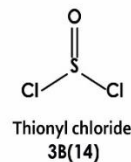
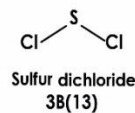
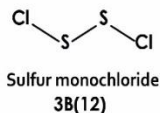
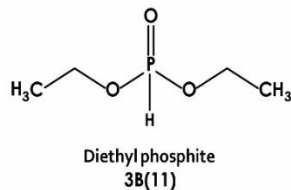
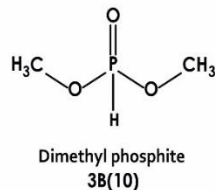
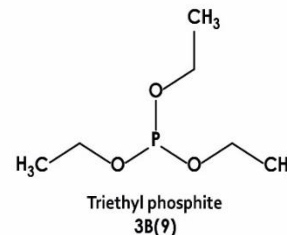
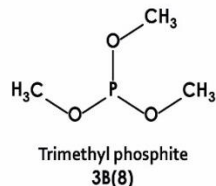
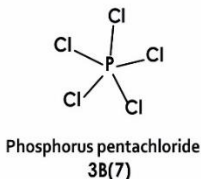
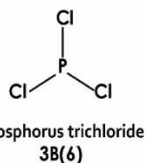
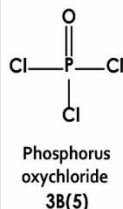
Schedule 3

Schedule 3

Schedule 3 Part A, Toxic Chemicals

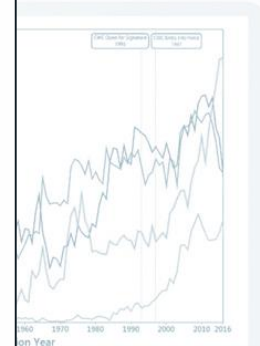
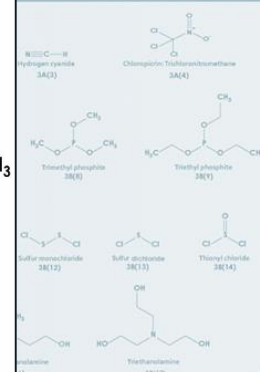


Schedule 3 Part B, Precursors



ule 3

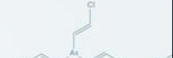
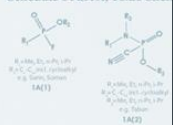
account in considering whether a toxic chemical is a chemical weapon; and purpose of this Convention because of its toxicity as well as other properties that make it a chemical weapon; and purpose of this Convention by virtue of its use for the production of chemical weapons in commercial quantities for purposes not



and 2. can have scientifically and economically early scientific publications that refer to them.

Guidelines for Scheduling
The following criteria shall be used in determining whether a chemical or precursor should be included in the Schedules:
(a) It has been developed primarily for purposes defined in Article II, paragraph 1, of the Convention;
(b) It poses otherwise than as a pesticide a high degree of toxicity because of its chemical or physical properties;
(c) It has little or no use for purposes other than those mentioned in (a) and (b).

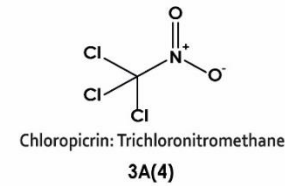
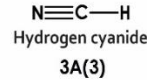
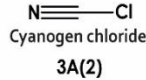
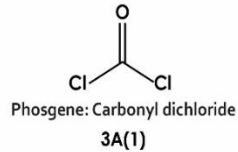
Schedule 1 Part A, Toxic Chemicals



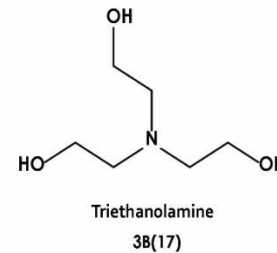
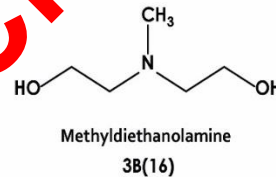
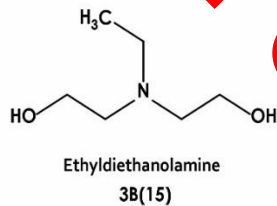
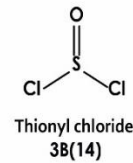
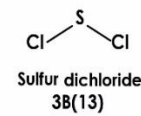
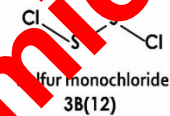
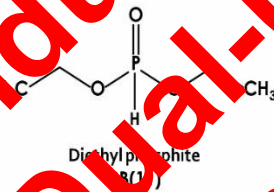
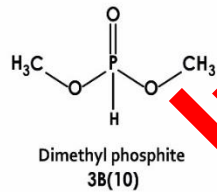
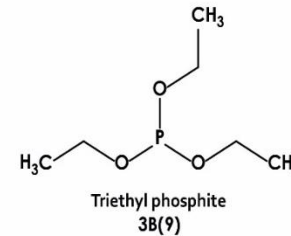
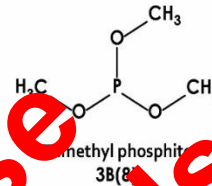
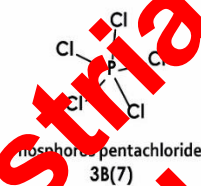
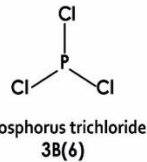
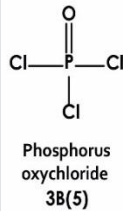
Schedule 3

Schedule 3

Schedule 3 Part A, Toxic Chemicals

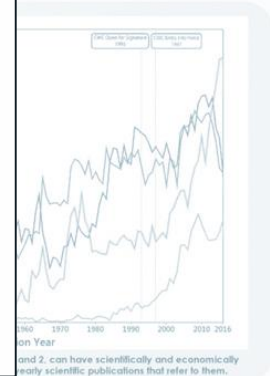
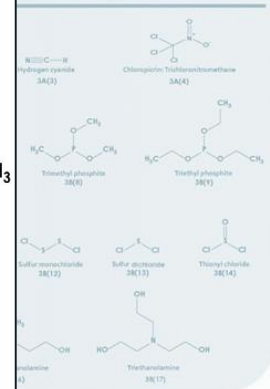


Schedule 3 Part B, Precursors



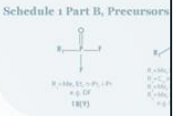
ule 3

account in considering whether a toxic chemical listed in Schedules 1 or 2, should be included in Schedule 3 as a chemical weapon; and purpose of this Convention because of its toxicity as well as other properties that make it a chemical weapon; and purpose of this Convention by virtue of its use for the production of chemical weapons or more chemicals listed in Schedule 1 or 2 in substantial quantities for purposes not otherwise permitted.



and 2. can have scientifically and economically early scientific publications that refer to them.

Guidelines for Scheduling
The following criteria shall be used in determining whether a chemical or precursor should be included in Schedules 1, 2 or 3:
(a) It has been developed primarily for purposes defined in Article II, paragraph 1, of the Convention;
(b) It poses otherwise than as a pesticide a high degree of toxicity because of its chemical or physical properties;
(c) It has little or no use for purposes other than those defined in Article II, paragraph 1, of the Convention.



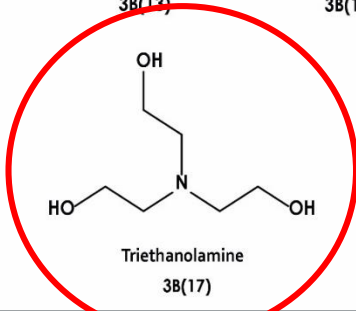
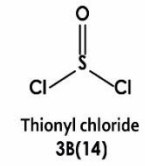
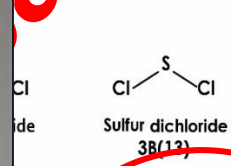
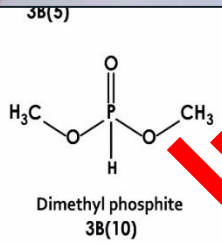
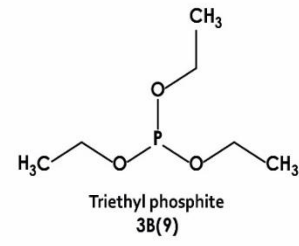
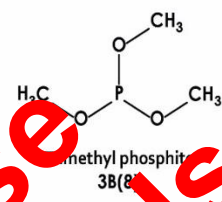
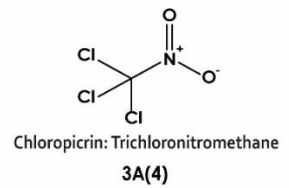
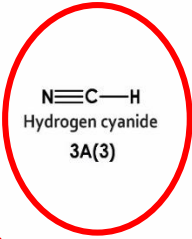
Scheduled Chemicals under the Chemical Weapons Convention (CWC)

Schedule 3

Schedule 3

Schedule 3 Part A, Toxic Chemicals

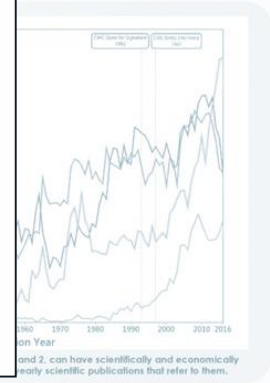
Guidelines for Sc...



ule 3

account in considering whether a toxic
er Schedules, should be included in
d as a chemical weapon;
and purpose of this Convention because it
toxicity as well as other properties that
l weapon;
urpose of this Convention by virtue of its
or more chemicals listed in Schedule 1 or
mmercial quantities for purposes not

Hydrogen cyanide 3A(3)
Chloropicrin: Trichloronitromethane 3A(4)
Triethyl phosphite 3B(9)
Triethyl phosphite 3B(9)
Sulfur dichloride 3B(13)
Sulfur dichloride 3B(13)
Thionyl chloride 3B(14)
Triethanolamine 3B(17)



Scheduled Chemicals under the Chemical Weapons Convention (CWC)

Schedule 3

Schedule 1

Guidelines for Schedule 1

The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention by virtue of its high potential for use in activities prohibited under this Convention because one or more of the following conditions are met:

Schedule 2

Guidelines for Schedule 2

The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:

- It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
- It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedules 1 or Schedules 2, part A.

Schedule 3

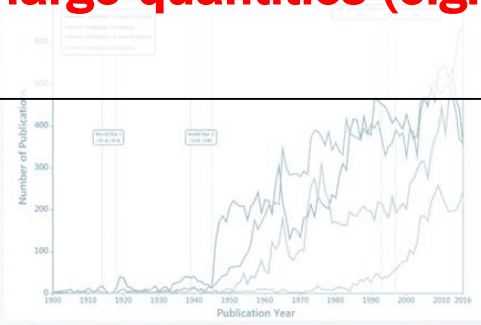
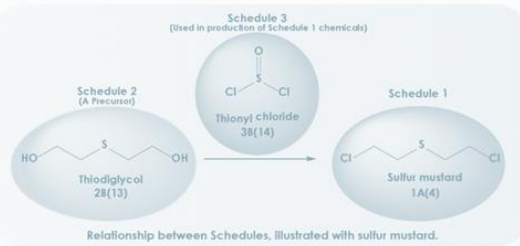
Guidelines for Schedule 3

The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- It has been produced, stockpiled or used as a chemical weapon;
- It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that might enable it to be used as a chemical weapon;

“Given the substantial changes in chemistry and chemical industry since the schedules were finalised a quarter century ago, a review of the schedules should be considered to assess whether: (a) the chemicals currently listed are in the appropriate Schedule, and (b) any toxic chemicals or specific precursors should be added to or removed from the Schedules. In this connection, it should be considered whether it is technically feasible to accurately monitor Schedule 3 chemicals that are produced in very large quantities (e.g. over 100,000 tons/year).”

Schedule 1 Part B, Precursors



Scheduled chemicals, including those in schedules 1 and 2, can have scientifically and economically important uses. This chart captures the number of yearly scientific publications that refer to them.



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Working Together for a World Free of Chemical Weapons

@opcw @opcw_at opcwonline opcwonline opcwonline opcw

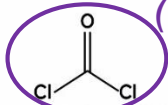
Scheduled Chemicals under the Chemical Weapons Convention (CWC)

Schedule 3

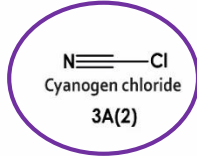
Schedule 3

Schedule 3 Part A, Toxic Chemicals

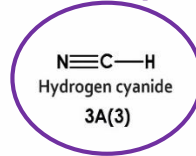
(isocyanates derived from phosgene)



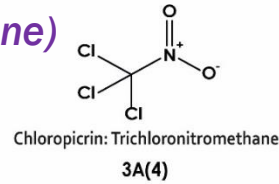
Phosgene: Carbonyl dichloride
3A(1)



Cyanogen chloride
3A(2)

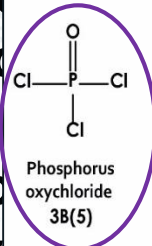


Hydrogen cyanide
3A(3)

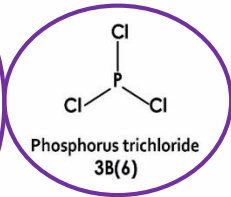


Chloropicrin: Trichloronitromethane
3A(4)

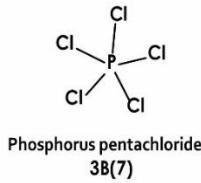
Schedule 3 Part B, Precursors



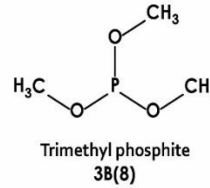
Phosphorus oxychloride
3B(5)



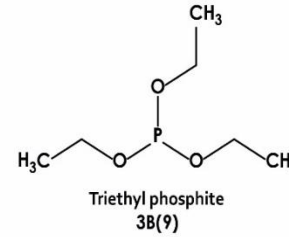
Phosphorus trichloride
3B(6)



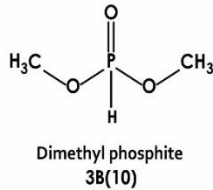
Phosphorus pentachloride
3B(7)



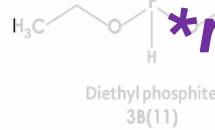
Trimethyl phosphite
3B(8)



Triethyl phosphite
3B(9)

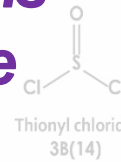


Dimethyl phosphite
3B(10)

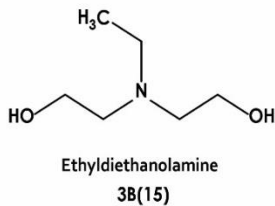


Diethyl phosphite
3B(11)

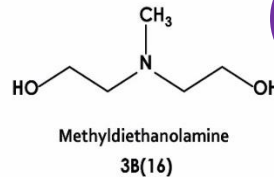
**Some of these chemicals
might qualify for the
> 100,000 club?**



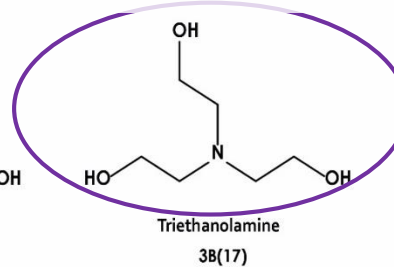
Thionyl chloride
3B(14)



Ethyldiethanolamine
3B(15)



Methyl-diethanolamine
3B(16)

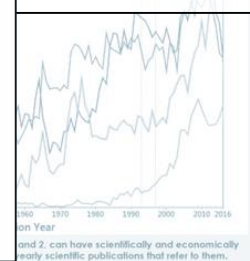


Triethanolamine
3B(17)

ule 3

account in considering whether a toxic chemical listed in Schedules 1, 2, or 3, should be included in the list of chemicals that are prohibited as a chemical weapon; and purpose of this Convention because of its toxicity as well as other properties that make it suitable for use as a chemical weapon;

Industry review of: (a) the... and (b) ... should be... by monitor... titles (e.g. ...)



and 2. can have scientifically and economically early scientific publications that refer to them.

Guidelines for S...
The following criteria sh...
chemical or precursor sho...
(a) It has been develop...
defined in Article II...
(b) It poses otherwise...
virtue of its high...
Convention becau...

“Given since the so chemi any to remov consid Sched over 1

Schedule 1 Part B, Precursors



ORGA
PROH
Working
@opcw



OPCW

What are on the Schedules?



OPCW

The Scheduled chemicals explicitly specified in the Convention for monitoring purposes, include chemical warfare agents and their key precursors

Scheduled chemicals are associated with historical chemical warfare programmes – *this does not mean they are chemical weapons...*

A Chemical Weapon:

Toxic chemicals and their precursors, except where intended for purposes not prohibited under this Convention as long as the types and quantities are consistent with such purposes (Article II).

The Scheduled chemicals explicitly specified in the Convention for purposes, include their key precursors

MOST TRADED SCHEDULED CHEMICALS 2017



ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

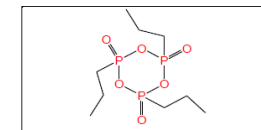
Most Traded Scheduled Chemicals ordered by Schedule

Schedule 2	CAS RN	Chemical Name	Page
2B04	129788-86-9	Product from the reaction of Methylphosphonic acid and 1,3,5-Triazine-2,4,6-triamine	1
2B04	170836-68-7	Mixture of (5-Ethyl-2-methyl-2-oxido-1,3,2-dioxaphosphinan-5-yl)methyl methyl methylphosphonate (CAS RN 41203-81-0) and Bis[(5-Ethyl-2-methyl-2-oxido-1,3,2-dioxaphosphinan-5-yl)methyl]methylphosphonate (CAS RN 42595-45-9)	2
2B04	18755-43-6	Dimethyl propylphosphonate	3
2B04	294675-51-7	Phosphonic acid, methyl-, polyglycol ester (Exolit OP 560 TP)	4
2B04	3001-98-7	3,9-Dimethyl-2,4,8,10-tetraoxa-3,9-diphosphaspiro[5.5]undecane 3,9-dioxide	5
2B04	363626-50-0	Bis(polyoxyethylene) methylphosphonate	6
2B04	41203-81-0	(5-Ethyl-2-methyl-2-oxido-1,3,2-dioxaphosphinan-5-yl)methyl methyl methylphosphonate	7
2B04	42595-45-9	Bis[(5-Ethyl-2-methyl-2-oxido-1,3,2-dioxaphosphinan-5-yl)methyl] methylphosphonate	8
2B04	4708-04-7	Propylphosphonic dichloride	9
2B04	63747-58-0	Poly(1,3-phenylene methyl phosphonate)	10
2B04	663176-00-9	Phosphonic acid, methyl-, polyglycol ester (Exolit OP 560)	11
2B04	676-97-1	Methylphosphonic dichloride	12

Page 13

Chemical Name:	2,4,6-Tripropyl-1,3,5,2,4,6-trioxatriphosphinane 2,4,6-trioxide
CAS RN:	68957-94-8
Schedule:	2B04
HS code:	2931.35
Molecular Formula:	C9H21O6P3
CAS Index Name:	1,3,5,2,4,6-Trioxatriphosphorinane, 2,4,6-tripropyl-, 2,4,6-trioxide
IUPAC Name:	2,4,6-Tripropyl-1,3,5,2,4,6-trioxatriphosphinane 2,4,6-trioxide
Synonyms:	Propylphosphonic anhydride n-Propylphosphonic cyclic anhydride 1-Propanephosphonic acid cyclic anhydride, 50% in ethyl acetate 1-Propanephosphonic acid cyclic anhydride

Chemical Structure



Commercial Applications & Industrial Uses

Used in: paper industry, pharmaceutical industry, plastics and synthetic resin industries, and peptide synthesis.

Used as flame retardant and paper making auxiliaries.

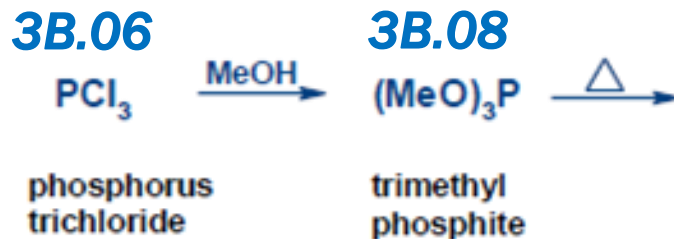
where intended for purposes
this Convention as long as th
are consistent with such purp

Precursors?



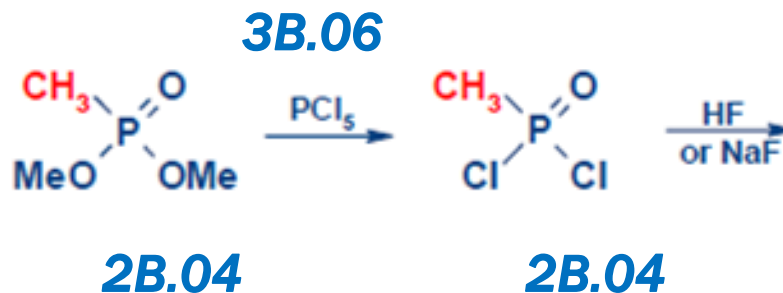
Chemical Warfare Agents and Precursors

Schedule 3



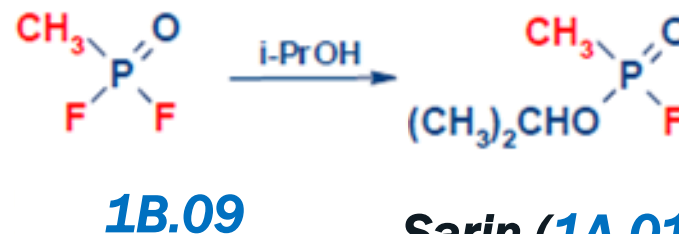
“Chemical weapon” (historical or potential)
Key precursor to S1 or S2(A)
Produced in large commercial quantities

Schedule 2



Potential chemical weapon;
Final stage or key precursor to S1 or S2(A)
Not produced in large commercial quantities

Schedule 1



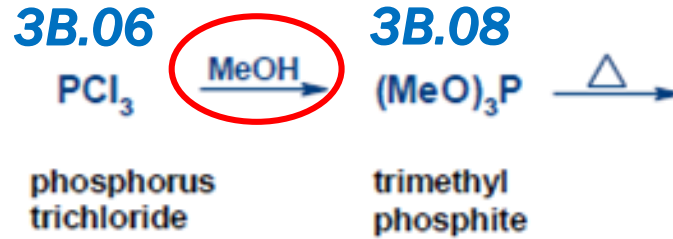
“Chemical weapon” (historical or potential)
Closely related chemical structure to S1(A)
Comparable properties to S1(A)
Final stage precursor to S1(A)
No (or limited) non-prohibited uses

Sarin (1A.01)
chemical warfare agent



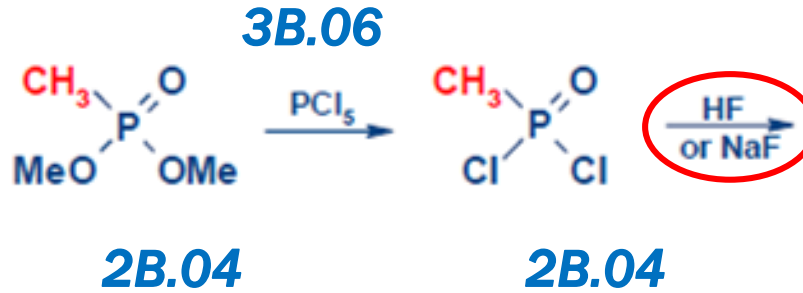
Chemical Warfare Agents and Precursors

Schedule 3



“Chemical weapon” (historical or potential)
Key precursor to S1 or S2(A)
Produced in large commercial quantities

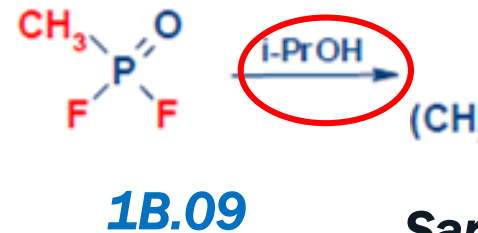
Schedule 2



Potential chemical weapon;
Final stage or key precursor to S1 or S2(A)
Not produced in large commercial quantities

Schedule 1

“Chemical weapon” (historical or potential)
Closely related chemical structure to S1(A)
Comparable properties to S1(A)
Final stage precursor to S1(A)
No (or limited) non-prohibited uses



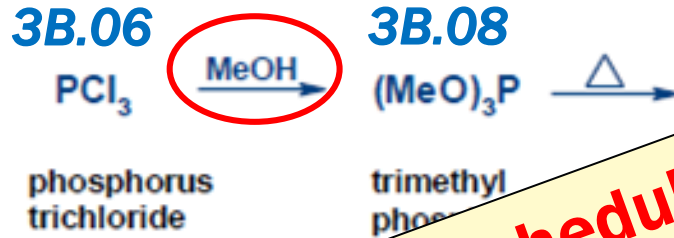
Sarin chemical agent



OPCW

Chemical Warfare Agents and Precursors

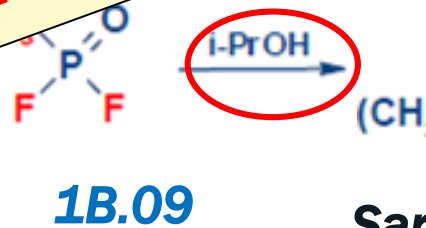
Schedule 3



"Chemical weapon" (historical or potential)
 Key precursor to S1 or S2(A)
 Produced in large commercial quantities

MeOH, i-PrOH, HF, NaF Unscheduled "Precursors"
(these are not considered "key" precursors)

If making sarin for prohibited uses, under Article II, these would be:
"Unscheduled Chemical Weapons"



Chemical weapon (historical or potential)
 Chemical structure to S1(A)
 Chemical properties to S1(A)
 Final use precursor to S1(A)
 No (or limited) non-prohibited uses

1B.09
Sarin
 chemical warfare agent



How Many Chemicals are Contained within the Schedules?

B. SCHEDULES OF CHEMICALS

The following Schedules list toxic chemicals and their precursors. For the purpose of implementing this Convention, these Schedules identify chemicals for the application of verification measures according to the provisions of the Verification Annex. Pursuant to Article II, subparagraph 1 (a), these Schedules do not constitute a definition of chemical weapons.

(Whenever reference is made to groups of dialkylated chemicals, followed by a list of alkyl groups in parentheses, all chemicals possible by all possible combinations of alkyl groups listed in the parentheses are considered as listed in the respective Schedule as long as they are not explicitly exempted. A chemical marked "*" on Schedule 2, part A, is subject to special thresholds for declaration and verification, as specified in Part VII of the Verification Annex.)

Schedule 1	(CAS registry number)
A. Toxic chemicals:	
(1) O-Alkyl ($\leq C_{10}$, incl. cycloalkyl) alkyl (Me, Et, n-Pr or i-Pr)-phosphonofluoridates	
e.g. Sarin: O-Isopropyl methylphosphonofluoridate	(107-44-8)
Soman: O-Pinacolyl methylphosphonofluoridate	(96-64-0)
(2) O-Alkyl ($\leq C_{10}$, incl. cycloalkyl) N,N-dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidocyanidates	
e.g. Tabun: O-Ethyl N,N-dimethyl phosphoramidocyanidate	(77-81-6)
(3) O-Alkyl (H or $\leq C_{10}$, incl. cycloalkyl) S-2-dialkyl (Me, Et, n-Pr or i-Pr)-aminoethyl alkyl (Me, Et, n-Pr or i-Pr) phosphonothiolates and corresponding alkylated or protonated salts	
e.g. VX: O-Ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate	(50782-69-9)
(4) Sulfur mustards:	
2-Chloroethylchloromethylsulfide	(2625-76-5)
Mustard gas: Bis(2-chloroethyl)sulfide	(505-60-2)
Bis(2-chloroethylthio)methane	(63869-13-6)
Sesquimustard: 1,2-Bis(2-chloroethylthio)ethane	(3563-36-8)
1,3-Bis(2-chloroethylthio)-n-propane	(63905-10-2)
1,4-Bis(2-chloroethylthio)-n-butane	(142868-93-7)
1,5-Bis(2-chloroethylthio)-n-pentane	(142868-94-8)
Bis(2-chloroethylthiomethyl)ether	(63918-90-1)
O-Mustard: Bis(2-chloroethylthioethyl)ether	(63918-89-8)

(5) Lewisties:	
Lewistate 1: 2-Chlorovinylchloroarsine	(541-25-3)
Lewistate 2: Bis(2-chlorovinyl)chloroarsine	(40334-69-8)
Lewistate 3: Tris(2-chlorovinyl)arsine	(40334-70-1)
(6) Nitrogen mustard:	
HN1: Bis(2-chloroethyl)ethylamine	(538-07-8)
HN2: Bis(2-chloroethyl)methylamine	(51-75-2)
HN3: Tris(2-chloroethyl)amine	(555-77-1)
(7) Saxitoxin	(35523-89-8)
(8) Ricin	(9009-86-3)
B. Precursors:	
(9) Alkyl (Me, Et, n-Pr or i-Pr) phosphonyldifluorides	
e.g. DF: Methylphosphonyldifluoride	(676-99-3)
(10) O-Alkyl (H or $\leq C_{10}$, incl. cycloalkyl) O-2-dialkyl (Me, Et, n-Pr or i-Pr)-aminoethyl alkyl (Me, Et, n-Pr or i-Pr) phosphonites and corresponding alkylated or protonated salts	
e.g. QL: O-Ethyl O-2-diisopropylaminoethyl methylphosphonite	(57856-11-8)
(11) Chlorosarin: O-Isopropyl methylphosphonochloridate	(1445-76-7)
(12) Chlorosoman: O-Pinacolyl methylphosphonochloridate	(7040-57-5)

Schedule 2	
A. Toxic chemicals:	
(1) Amton: O,O-Diethyl S-[2-(diethylamino)ethyl] phosphorothiolate and corresponding alkylated or protonated salts	(78-53-5)
(2) PFIB: 1,1,3,3,3-Pentafluoro-2-(trifluoromethyl)-1-propene	(382-21-8)
(3) BZ: 3-Quinuclidinyl benzilate (*)	(6581-06-2)
B. Precursors:	
(4) Chemicals, except for those listed in Schedule 1, containing a phosphorus atom to which is bonded one methyl, ethyl or propyl (normal or iso) group but not further carbon atoms.	
e.g. Methylphosphonyl dichloride	(676-97-1)
Dimethyl methylphosphonate	(756-79-6)
Exemption: Fonofos: O-Ethyl S-phenyl ethylphosphonodithiothionate	(944-22-9)
(5) N,N-Dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidic dihalides	
(6) Dialkyl (Me, Et, n-Pr or i-Pr) N,N-dialkyl (Me, Et, n-Pr or i-Pr)-phosphoramidates	
(7) Arsenic trichloride	(7784-34-1)
(8) 2,2-Diphenyl-2-hydroxyacetic acid	(76-93-7)
(9) Quinuclidin-3-ol	(1619-34-7)
(10) N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethyl-2-chlorides and corresponding protonated salts	
(11) N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethane-2-ols and corresponding protonated salts	
Exemptions: N,N-Dimethylaminoethanol and corresponding protonated salts	(108-01-0)
N,N-Diethylaminoethanol and corresponding protonated salts	(100-37-8)
(12) N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethane-2-thiols and corresponding protonated salts	
(13) Thioglycol: Bis(2-hydroxyethyl)sulfide	(111-48-8)
(14) Pinacolyl alcohol: 3,3-Dimethylbutan-2-ol	(464-07-3)

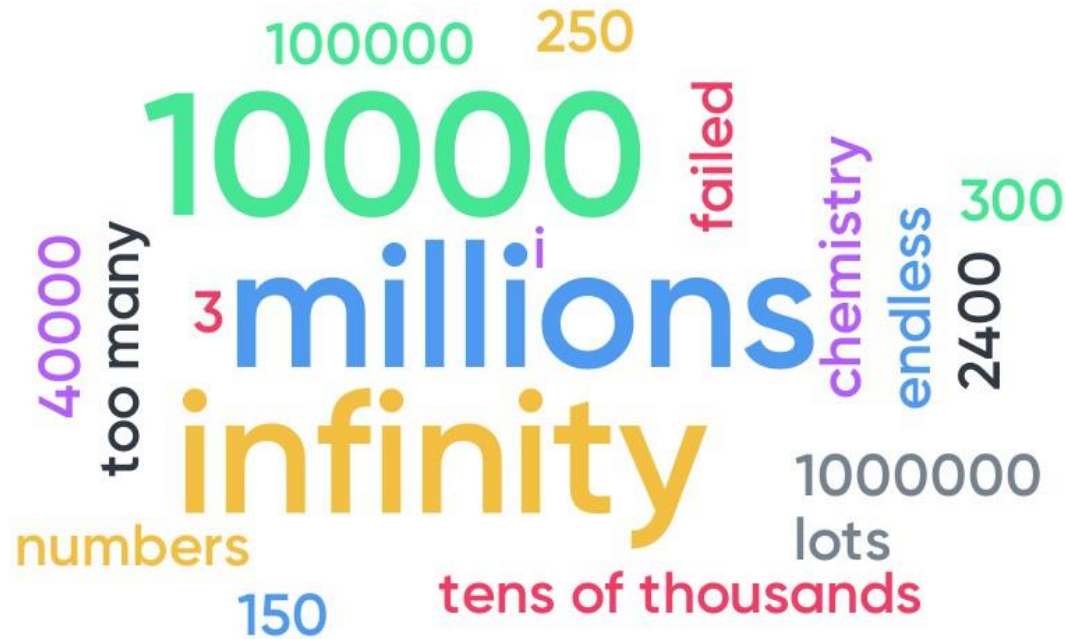
Schedule 3	
A. Toxic chemicals:	
(1) Phosgene: Carbonyl dichloride	(75-44-5)
(2) Cynogen chloride	(506-77-4)
(3) Hydrogen cyanide	(74-90-8)
(4) Chloropicrin: Trichloronitromethane	(76-06-2)
B. Precursors:	
(5) Phosphorus oxychloride	(10025-87-3)
(6) Phosphorus trichloride	(7719-12-2)
(7) Phosphorus pentachloride	(10026-13-8)
(8) Trimethyl phosphite	(121-45-9)
(9) Triethyl phosphite	(122-52-1)
(10) Dimethyl phosphite	(868-85-9)
(11) Diethyl phosphite	(762-04-9)
(12) Sulfur monochloride	(10025-67-9)
(13) Sulfur dichloride	(10545-99-0)
(14) Thionyl chloride	(7719-09-7)
(15) Ethyldiethanolamine	(139-87-7)
(16) Methyl-diethanolamine	(105-59-9)
(17) Triethanolamine	(102-71-6)



Answers from the Audience

How many chemicals are contained within the Schedules?

Mentimeter



18



OPCW

and corresponding protonated salts		(17) Triethanolamine	(102-71-6)
Exemptions: NN-Dimethylaminoethanol and corresponding protonated salts	(108-01-0)		
NN-Diethylaminoethanol and corresponding protonated salts	(100-37-8)		
(12) NN-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethane-2-thiols and corresponding protonated salts			
(13) Thiodiglycol: Bis(2-hydroxyethyl)sulfide	(111-48-8)		
(14) Pinacolyl alcohol: 3,3-Dimethylbutan-2-ol	(464-07-3)		

How Many Chemicals are Contained within the Schedules?

**Chemical Abstracts
Service (CAS)
Registry Numbers**

B. SCHEDULES OF CHEMICALS

The following Schedules list toxic chemicals and their precursors. For the purpose of implementing this Convention, these Schedules identify chemicals for the application of verification measures according to the provisions of the Verification Annex. Pursuant to Article II, subparagraph 1 (a), these Schedules do not constitute a definition of chemical weapons.

(Whenever reference is made to groups of dialkylated chemicals, followed by a list of alkyl groups in parentheses, all chemicals possible by all possible combinations of alkyl groups listed in the parentheses are considered as listed in the respective Schedule as long as they are not explicitly exempted. A chemical marked "*" on Schedule 2, part A, is subject to special thresholds for declaration and verification, as specified in Part VII of the Verification Annex.)

Schedule 1 (CAS registry number)

A. Toxic chemicals:

(1) O-Alkyl ($\leq C_{10}$, incl. cycloalkyl) alkyl (Me, Et, n-Pr or i-Pr)-phosphonofluoridates
 e.g. Sarin: O-Isopropyl methylphosphonofluoridate (107-44-8)
 Soman: O-Pinacolyl methylphosphonofluoridate (96-64-0)

(2) O-Alkyl ($\leq C_{10}$, incl. cycloalkyl) N,N-dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidocyanidates
 e.g. Tabun: O-Ethyl N,N-dimethyl phosphoramidocyanidate (77-81-6)

(3) O-Alkyl (H or $\leq C_{10}$, incl. cycloalkyl) S-2-dialkyl (Me, Et, n-Pr or i-Pr)-aminoethyl alkyl (Me, Et, n-Pr or i-Pr) phosphonothiolates and corresponding alkylated or protonated salts
 e.g. VX: O-Ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate (50782-69-9)

(4) Sulfur mustards:
 2-Chloroethylchloromethylsulfide (2625-76-5)
 Mustard gas: Bis(2-chloroethyl)sulfide (505-60-2)
 Bis(2-chloroethylthio)methane (63869-13-6)
 Sesquimustard: 1,2-Bis(2-chloroethylthio)ethane (3563-36-8)
 1,3-Bis(2-chloroethylthio)-n-propane (63905-10-2)
 1,4-Bis(2-chloroethylthio)-n-butane (142868-93-7)
 1,5-Bis(2-chloroethylthio)-n-pentane (142868-94-8)
 Bis(2-chloroethylthio)methyl ether (63918-90-1)
 O-Mustard: Bis(2-chloroethylthio)ethyl ether (63918-89-8)

descriptions/formulas

(5) Lewisites:
 Lewisite 1: 2-Chlorovinylchloroarsine (541-25-3)
 Lewisite 2: Bis(2-chlorovinyl)chloroarsine (40334-69-8)
 Lewisite 3: Tris(2-chlorovinyl)arsine (40334-70-1)

(6) Nitrogen mustard:
 HN1: Bis(2-chloroethyl)ethylamine (538-07-8)
 HN2: Bis(2-chloroethyl)methylamine (51-75-2)
 HN3: Tris(2-chloroethyl)amine (555-77-1)

(7) Saxitoxin (35523-89-8)

(8) Ricin (9009-86-3)

B. Precursors:

(9) O-Alkyl (Me, Et, n-Pr or i-Pr) phosphonyldifluorides
 e.g. DF: Methylphosphonyldifluoride (676-99-3)

(10) O-Alkyl (H or $\leq C_{10}$, incl. cycloalkyl) O-2-dialkyl (Me, Et, n-Pr or i-Pr)-aminoethyl alkyl (Me, Et, n-Pr or i-Pr) phosphonites and corresponding alkylated or protonated salts
 e.g. QL: O-Ethyl O-2-diisopropylaminoethyl methylphosphonite (57856-11-8)

(11) Chlorosarin: O-Isopropyl methylphosphonochloridate (1445-76-7)

(12) Chlorosoman: O-Pinacolyl methylphosphonochloridate (7040-57-5)

Schedule 2

A. Toxic chemicals:

(1) Amion: O,O-Diethyl S-[2-(diethylamino)ethyl] phosphorothiolate and corresponding alkylated or protonated salts (78-53-5)

(2) PFIB: 1,1,3,3,3-Pentafluoro-2-(trifluoromethyl)-1-propene (382-21-8)

(3) BZ: 3-Quinuclidinyl benzilate (*) (6581-06-2)

B. Precursors:

(4) Chemicals, except for those listed in Schedule 1, containing a phosphorus atom to which is bonded one methyl, ethyl or propyl (normal or iso) group but not further carbon atoms.
 e.g. Methylphosphonyl dichloride (676-97-1)
 Dimethyl methylphosphonate (756-79-6)
 Exemption: Fonofos: O-Ethyl S-phenyl ethylphosphonodithiothionate (944-22-9)

(5) NN-Dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidic dihalides

(6) Dialkyl (Me, Et, n-Pr or i-Pr) NN-dialkyl (Me, Et, n-Pr or i-Pr)-phosphoramidates

(7) Arsenic trichloride (7747-86-5)

(8) 2,2-Diphenyl-2-hydroxyacetic acid (10545-99-0)

(9) Quinuclidin-3-ol (7719-09-7)

(10) NN-Dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidates and corresponding alkylated or protonated salts (139-87-7)

(11) NN-Dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidates and corresponding alkylated or protonated salts (105-59-9)

(12) NN-Dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidates and corresponding alkylated or protonated salts (102-71-6)

Specific chemicals

Schedule 2

A. Toxic chemicals:

(1) Phosgene: Carbonyl dichloride (75-44-5)

(2) Cyanogen chloride (506-77-4)

(3) Hydrogen cyanide (74-90-8)

(4) Chloropicrin: Trichloronitromethane (76-06-2)

B. Precursors:

(5) Phosphorus oxychloride

(6) Phosphorus trichloride

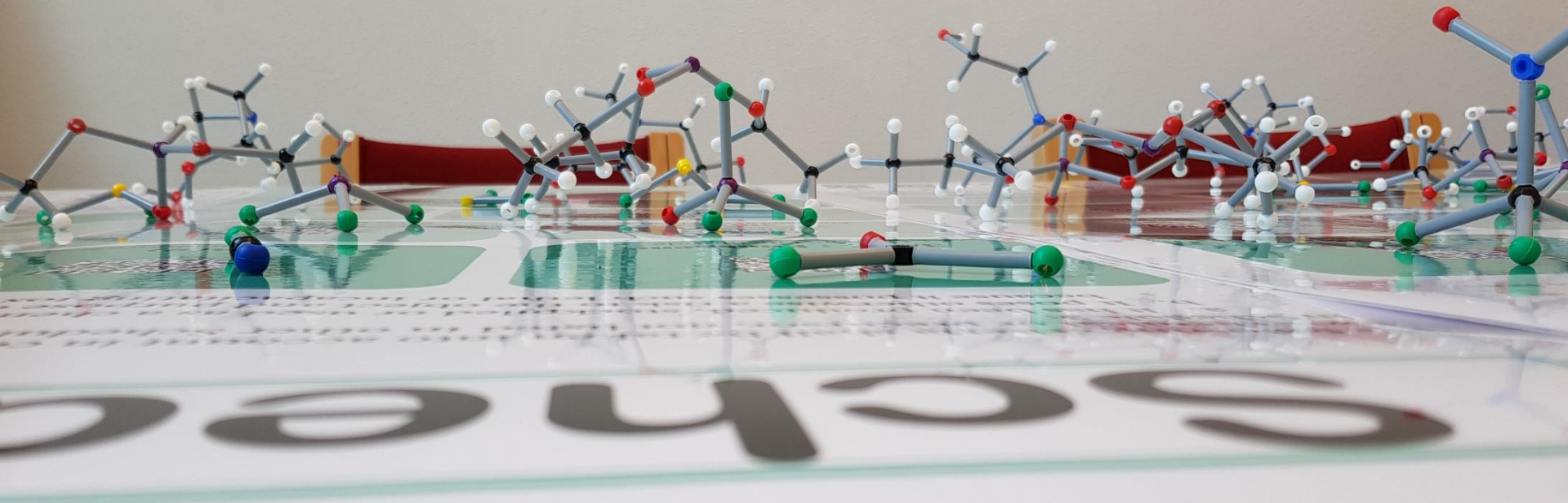
(7) Phosphorus pentachloride

(8) Trimethyl phosphite

(9) ...

53 specific chemicals are listed by chemical name, CAS number and/or uniquely defined chemical formula (3 are exemptions to the Schedule they would otherwise fall under)

A Matter of Atoms and Molecules



Scheduled Chemicals under the Chemical Weapons Convention (CWC)

Schedule 1

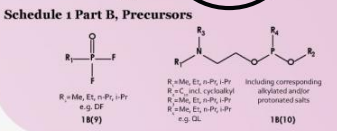
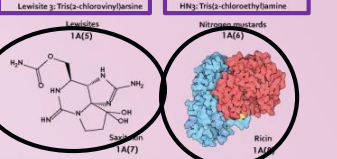
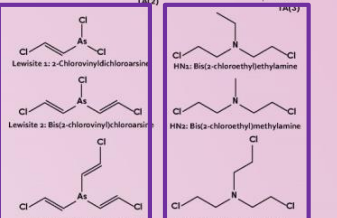
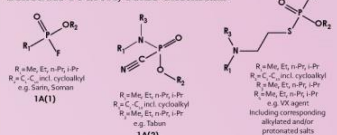
Guidelines for Schedule 1

The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- (a) It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article I;
- (b) It poses otherwise a high risk to the object and purpose of this Convention by virtue of its importance to the production of one or more chemicals listed in Schedule 1, or because of one or more of the following conditions:
 - (i) It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, important properties similar to those of such other chemicals, as well as other properties that would enable it to be used as a chemical weapon;
 - (ii) It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;
- (c) It has little or no use for purposes not prohibited under this Convention.

3 Groups of compounds (15 compounds in total)

Schedule 1 Part A, Toxic Chemicals

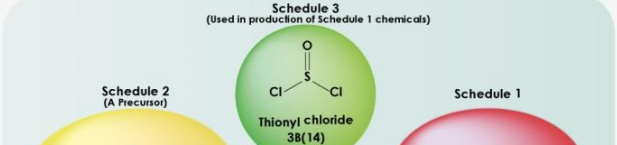
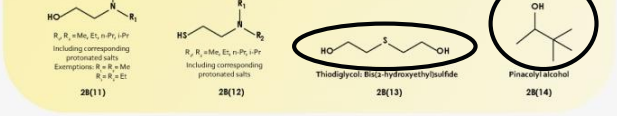
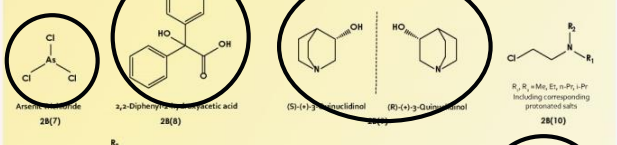
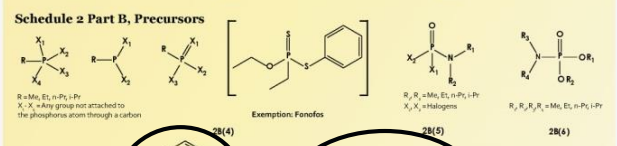
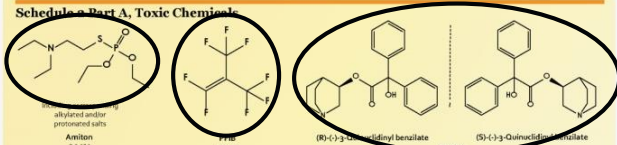


Schedule 2

Guidelines for Schedule 2

The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical should be included in Schedule 2, part A, should be included in Schedule 2:

- (a) It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating properties that could enable it to be used as a chemical weapon;
- (b) It may be used as a precursor in one of the final single technological stages of formation of a chemical listed in Schedule 1 or Schedule 2, part A;
- (c) It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 2, part A;
- (d) It is not produced in large commercial quantities for purposes not prohibited under this Convention.



Relationship between Schedules, illustrated with sulfur mustard.

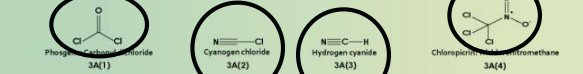
Schedule 3

Guideline for Schedule 3

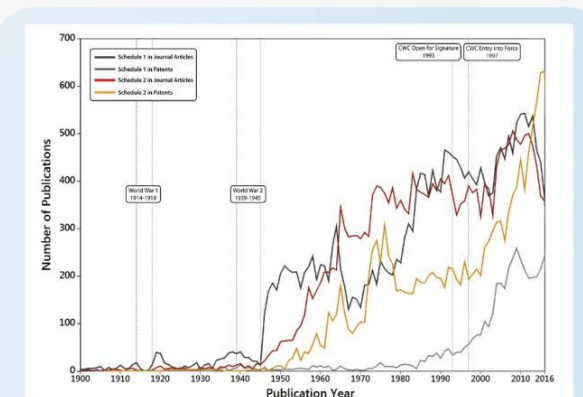
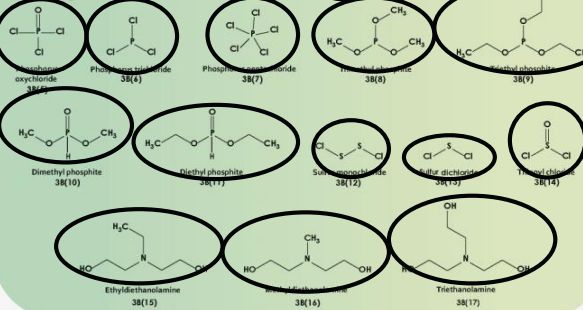
The following criteria shall be taken into account in considering whether a toxic chemical or precursor to a Schedule 1 chemical should be included in Schedule 3:

- (a) It has been produced, stockpiled or used as a chemical weapon;
- (b) It poses otherwise a high risk to the object and purpose of this Convention because it possesses such lethal or incapacitating properties that could enable it to be used as a chemical weapon;
- (c) It poses a risk to the object and purpose of this Convention by virtue of its importance to the production of one or more chemicals listed in Schedule 1 or Schedule 2, part A, for purposes not prohibited under this Convention.

Schedule 3 Part A, Toxic Chemicals



Schedule 3 Part B, Precursors



Scheduled chemicals, including those in schedules 1 and 2, can have scientifically and economically important uses. This chart captures the number of yearly scientific publications that refer to them.

Scheduled Chemicals under the Chemical Weapons Convention (CWC)

Schedule 1

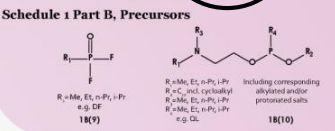
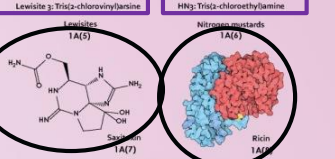
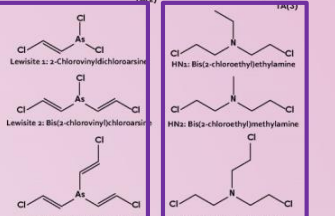
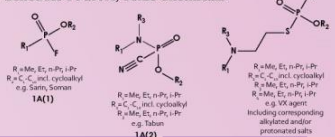
Guidelines for Schedule 1

The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- (a) It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article I;
- (b) It poses a high risk to the object and purpose of this Convention by virtue of its importance to the production of one or more chemicals listed in Schedule 1, or because of one or more of the following conditions:
 - (i) It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, one or more properties that would enable it to be used as a chemical weapon;
 - (ii) It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, one or more properties that would enable it to be used as a chemical weapon;
- (iii) It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;
- (c) It has little or no use for purposes not prohibited under this Convention.

3 Groups of compounds (15 compounds in total)

Schedule 1 Part A, Toxic Chemicals



Schedule 2

Guidelines for Schedule 2

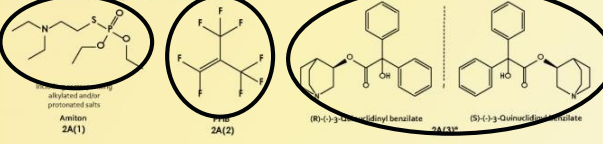
The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical should be included in Schedule 2, part A, should be included in Schedule 2:

- (a) It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating properties that it could enable it to be used as a chemical weapon in one of the final stages of formation of a chemical listed in Schedule 1 or Schedule 2, part A;
- (b) It may be used as a precursor in one of the final stages of formation of a chemical listed in Schedule 1 or Schedule 2, part A;
- (c) It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 2, part A;
- (d) It is not produced in large commercial quantities for purposes not prohibited under this Convention.

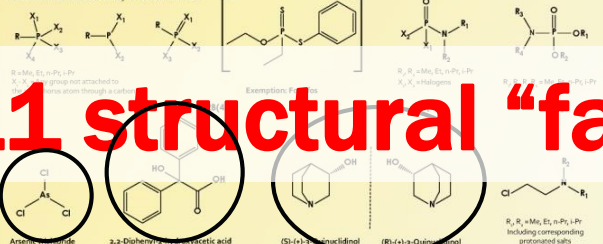
27 Single chemical substances

2 Single chemical substances shown here as stereoisomers

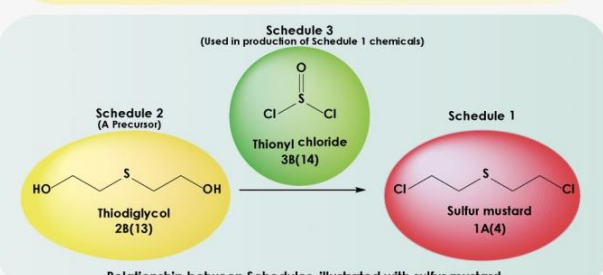
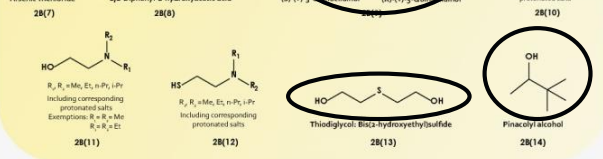
Schedule 2 Part A, Toxic Chemicals



Schedule 2 Part B, Precursors



And 11 structural "families"



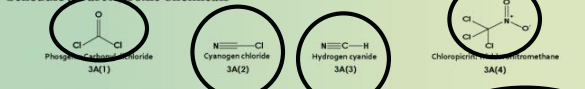
Schedule 3

Guidelines for Schedule 3

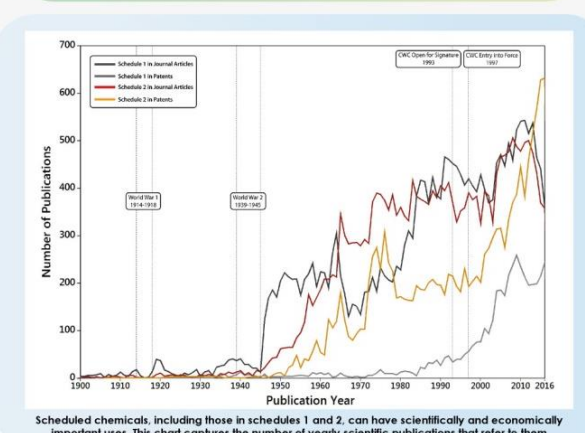
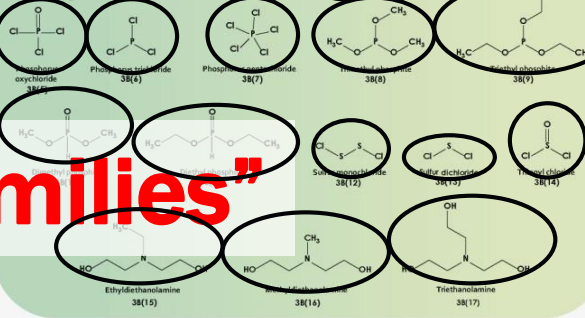
The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical should be included in Schedule 3:

- (a) It has been produced, stockpiled or used as a chemical weapon;
- (b) It poses a risk to the object and purpose of this Convention by virtue of its importance to the production of one or more chemicals listed in Schedule 1 or Schedule 2, part A;
- (c) It poses a risk to the object and purpose of this Convention by virtue of its importance to the production of one or more chemicals listed in Schedule 1 or Schedule 2, part A;

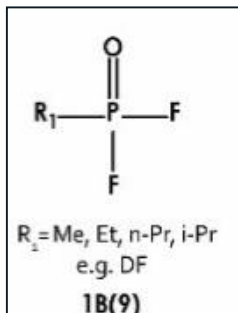
Schedule 3 Part A, Toxic Chemicals



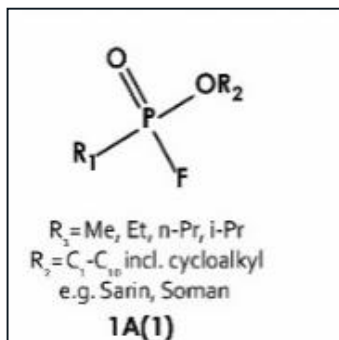
Schedule 3 Part B, Precursors



Families of Chemicals?



■ 1B.09: Four members



■ 1A.01

- R_1 has four possible structures

- *What about R_2 ?*

$R_2 = \text{C}_1$ (-CH₃), 1 structure X 4 = **4 1A.01 chemicals**

$R_2 = \text{C}_2$ (-CH₂CH₃), 1 structure X 4 = **4 1A.01 chemicals**

$R_2 = \text{C}_3$ (-CH₂CH₂CH₃ or -CH(CH₃)₂ or Δ), 3 structures X 4 = **12 1A.01 chemicals**

Includes sarin

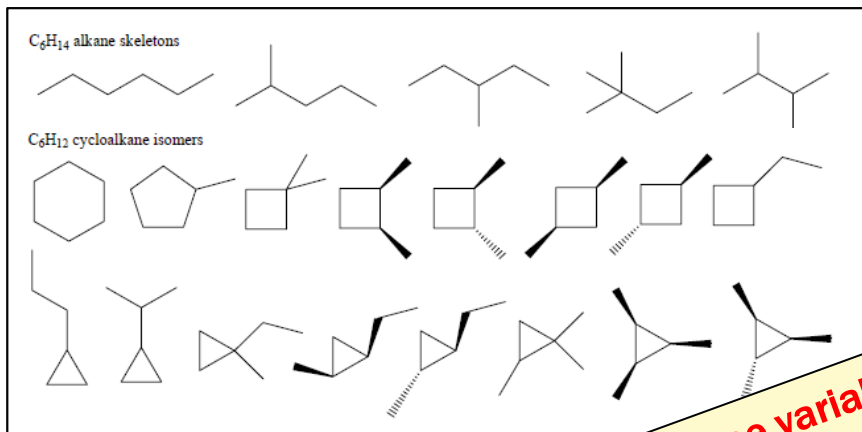
■
■
■
 $R_2 = \text{C}_6$

21 structures

83 ways of attachment

332 1A.01 chemicals

Includes soman, cyclosarin



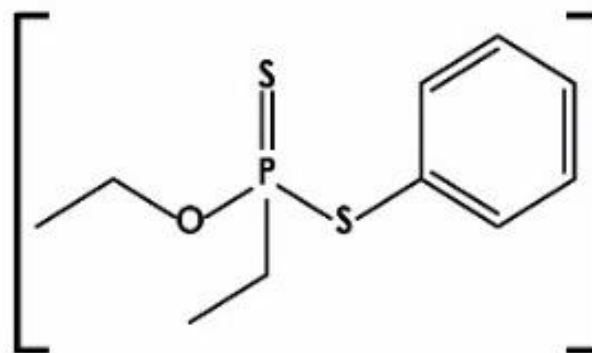
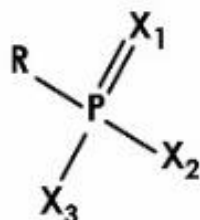
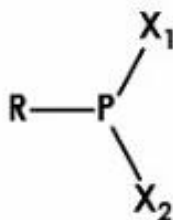
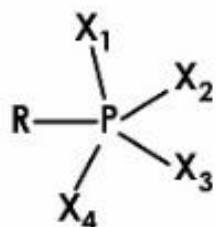
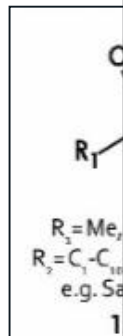
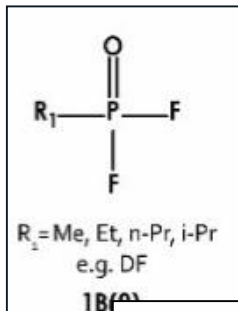
With one variable R group from C1 to C10 for 1A.01, 1A.02 and 1A.03: > 1.3 million possible chemicals in these three Schedules



OPCW

Families of Chemicals?

- 1B.09: Four members



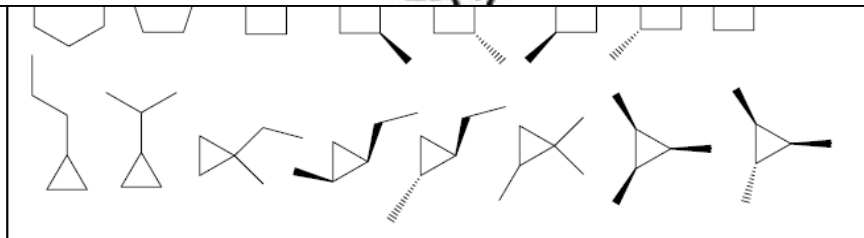
3:

$\text{R} = \text{Me, Et, n-Pr, i-Pr}$
 $\text{X}_1 - \text{X}_4 = \text{Any group not attached to the phosphorus atom through a carbon}$

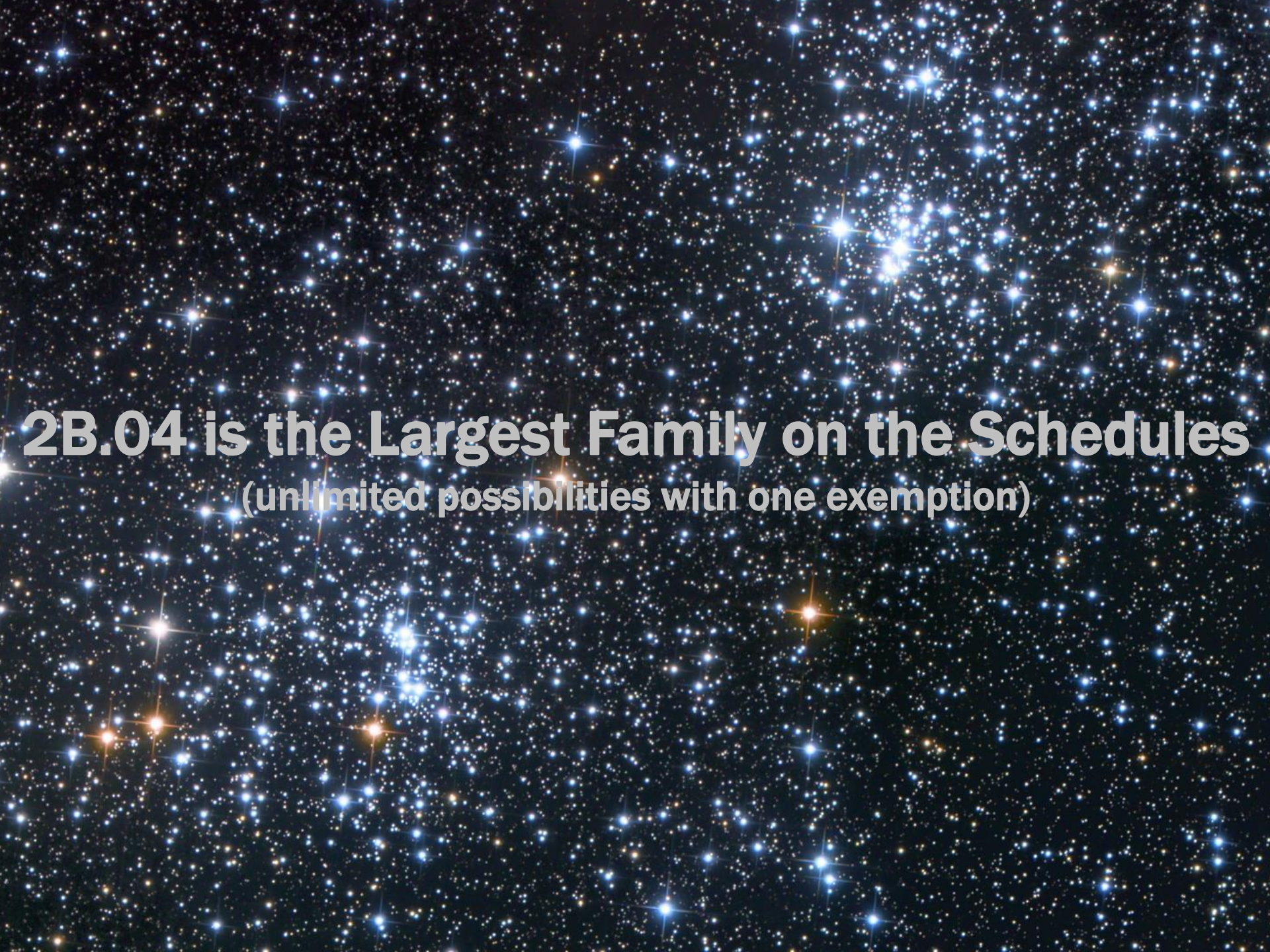
Exemption: Fonofos

chemicals
es sarin

2B(4)



83
 332
 Includes sarin, cyclosarin



2B.04 is the Largest Family on the Schedules
(unlimited possibilities with one exemption)

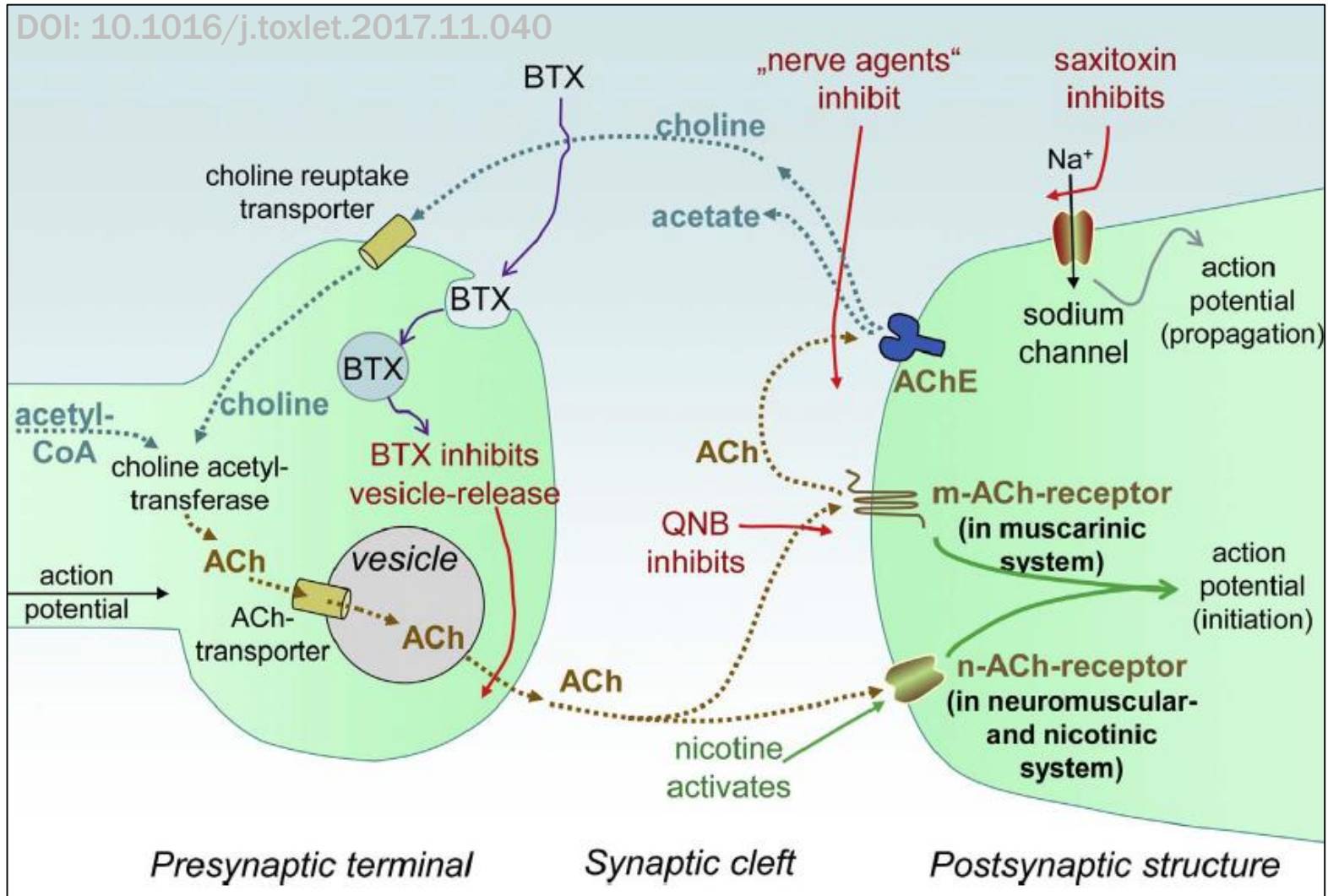
Is that all a bit too Complicated?



OPCW

Is that all a bit too Complicated?

DOI: 10.1016/j.toxlet.2017.11.040



Is that all a bit too Complicated?

DOI: 10.1016/j.toxlet.2017.11.040

$$\begin{array}{c}
 \text{O} \\
 \parallel \\
 \text{R}_1 - \text{P} - \text{OR}_2 \\
 \mid \\
 \text{F}
 \end{array}$$

$\text{R}_1 = \text{Me, Et, n-Pr, i-Pr}$
 $\text{R}_2 = \text{C}_1 - \text{C}_{10}$ incl. cycloalkyl
 e.g. Sarin, Soman
1A(1)

Why stop at C₁₀?

DOI: 10.1021/acschemneuro.8b00148

Sarin: $-\text{CH}(\text{CH}_3)_2$

$$\text{Ser}^{203} - \text{OH} + \begin{array}{c} \text{F} \\ | \\ \text{R}_1 - \text{P} - \text{O} - \text{R}_3 \\ || \\ \text{R}_2 \\ | \\ -\text{CH}_3 \end{array} \longrightarrow \text{Ser}^{203} - \text{O} - \begin{array}{c} \text{O} \\ || \\ \text{P} - \text{O} - \text{R}_3 \\ | \\ \text{R}_2 \end{array}$$

Free enzyme + Free nerve agent → Non-aged adduct

Presynaptic terminal

Synaptic cleft

(in neuromuscular- and nicotinic system)

Postsynaptic structure

Is that all a bit too Complicated?

DOI: 10.1006

action potential propagation

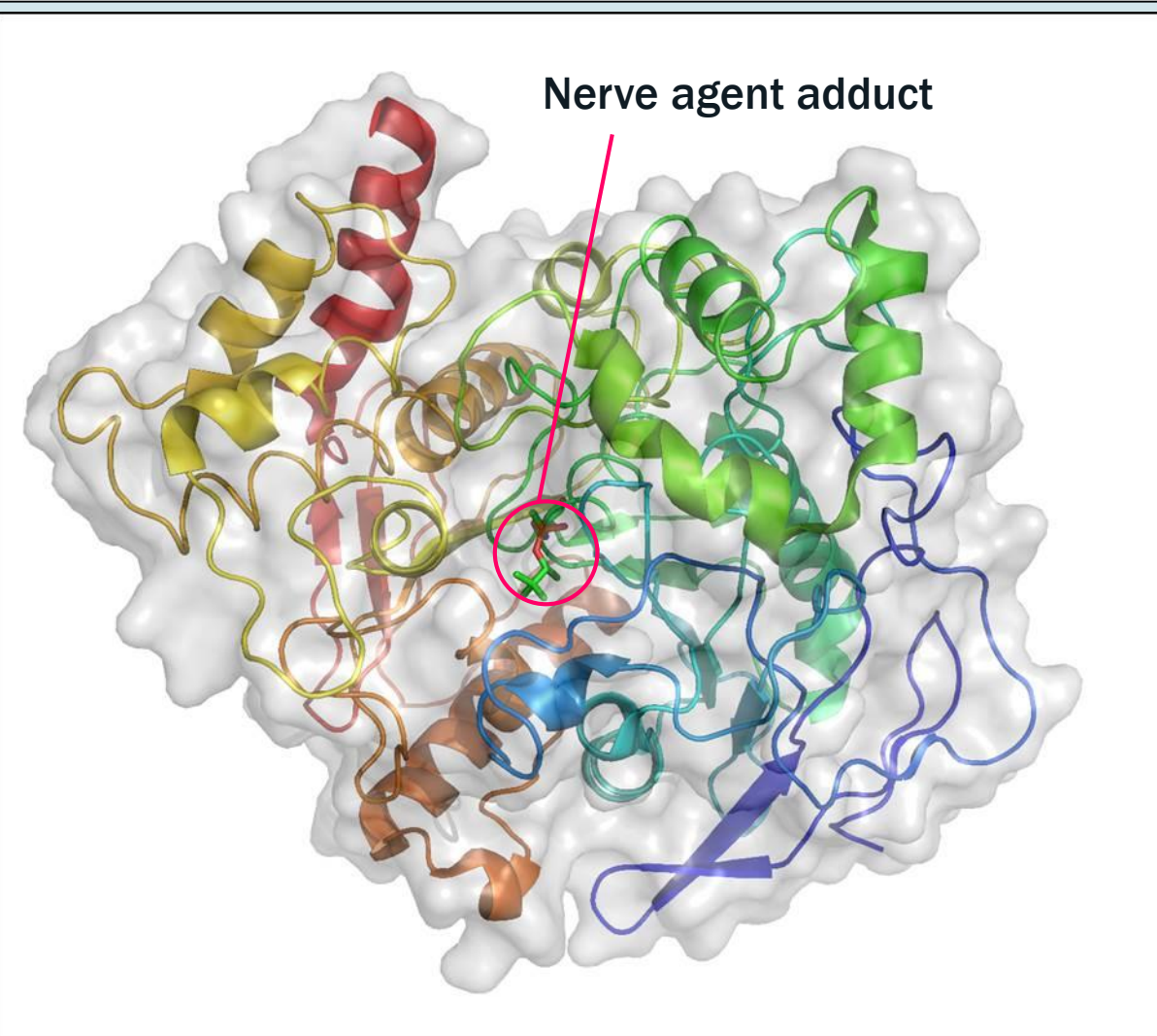
neuro.8b00148

acetyl-CoA chromatin trans

action potential →

Pr

Nerve agent adduct



$$\begin{array}{c} \text{O} \\ \parallel \\ \text{O}-\text{P}-\text{O}-\text{R}_3 \\ | \\ \text{R}_2 \end{array}$$

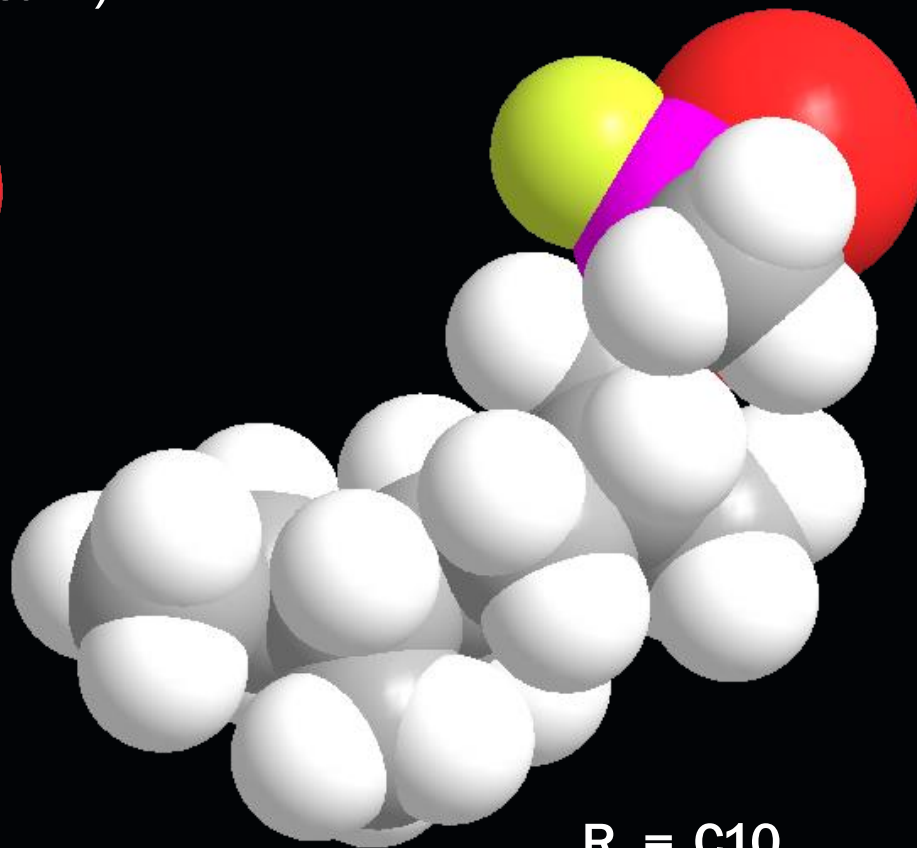
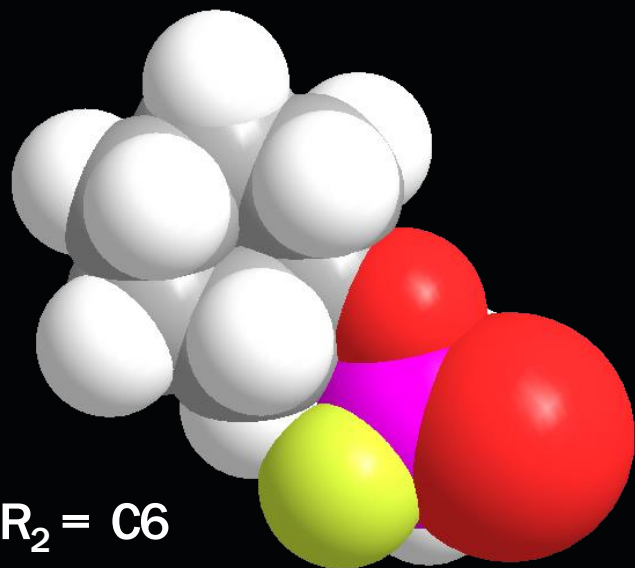
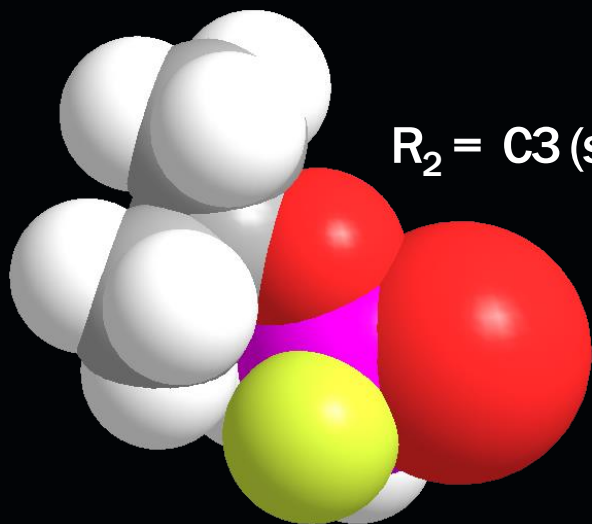
d adduct

structure

The image shows a 3D ribbon diagram of a protein structure, likely an acetylcholinesterase, with a white surface representation. The protein is colored in various shades: red, yellow, green, blue, and orange. A red circle highlights a specific region of the protein, labeled 'Nerve agent adduct' with a red line pointing to it. The diagram is surrounded by various text elements and a chemical structure. On the left, there is a vertical bar with labels 'DOI: 10.1006', 'action potential propagation', 'acetyl-CoA chromatin trans', 'action potential →', and 'Pr'. On the right, there is a vertical bar with labels 'neuro.8b00148', 'd adduct', and 'structure'. In the center-right, there is a chemical structure of a phosphate group with three substituents: R2, R3, and an oxygen atom bonded to a carbon chain.



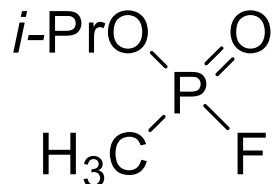
A Matter of Size



Families also help to mitigate issues of “designer” compounds being exempt from monitoring and control



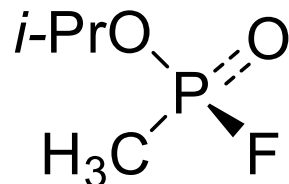
Are Individual Chemicals any Less Complicated?



Sarin

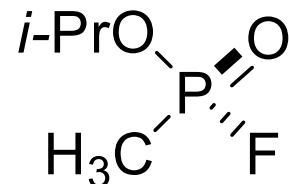
CAS 107-44-8

Schedule 1.A.01



(*R*)-(-)-Sarin

CAS 6171-94-4



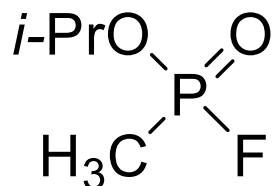
(*S*)-(+)-Sarin

CAS 6171-93-3



OPCW

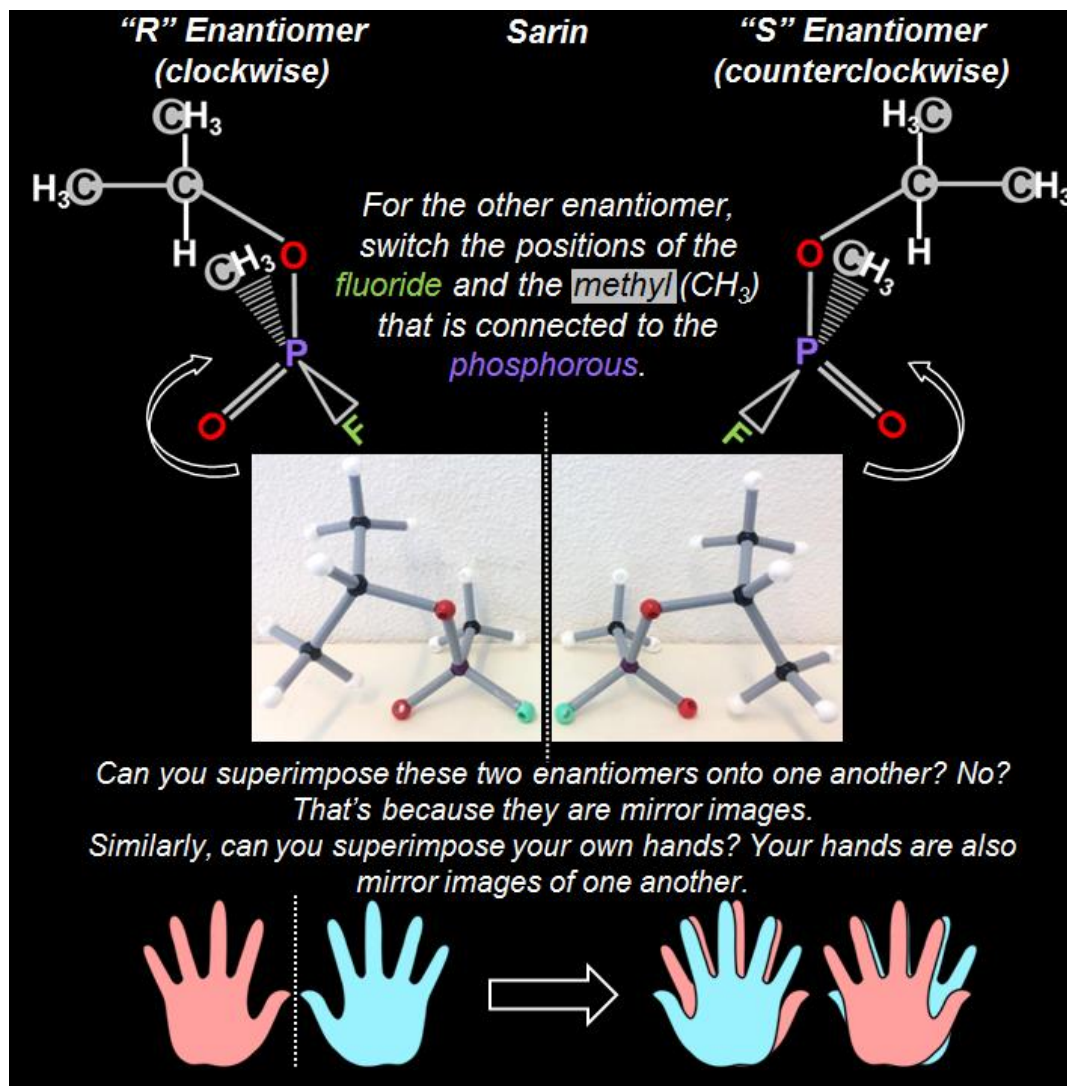
Are Individual Chemicals any Less Complicated?



Sarin

CAS 107-44-8

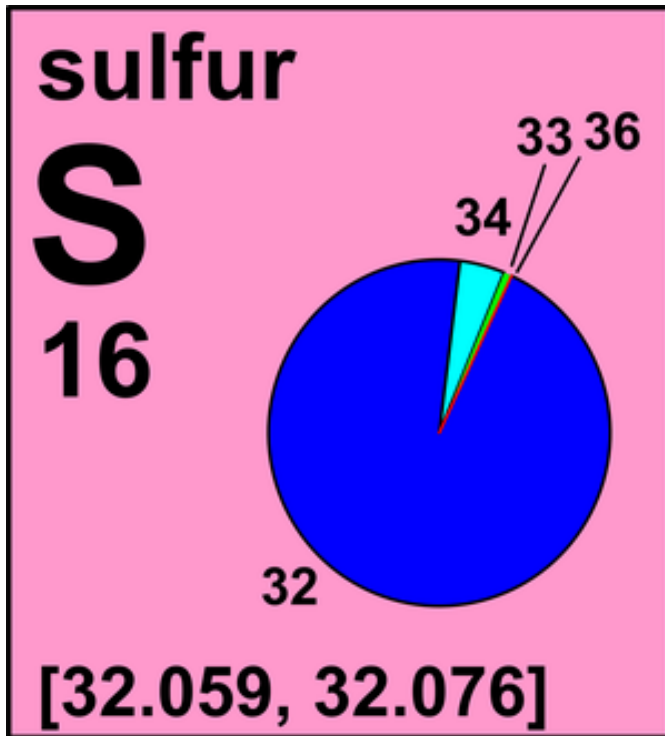
Schedule 1.A.01



OPCW

Stereoisomers should still fall under the Schedule of the parent compound (SAB Recommendation)

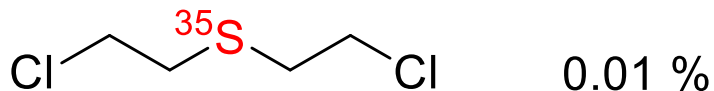
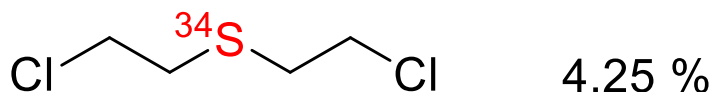
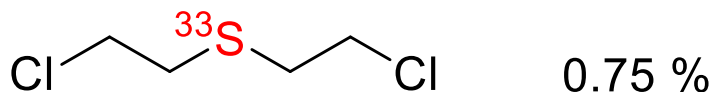
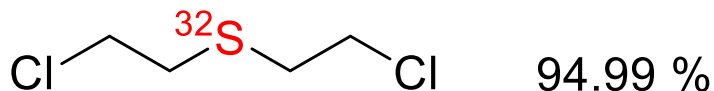
ISOTOPES



16 protons
+
16, 17, 18 or 19 neutrons
=
4 isotopes (³²S, ³³S, ³⁴S, ³⁵S)

ISOTOPES

Isotopically labeled chemicals should still fall under the Schedule of the parent compound (SAB Recommendation)

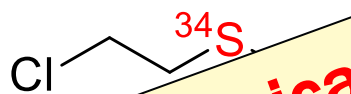
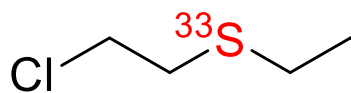
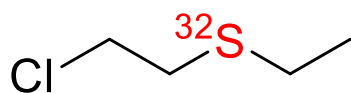


sulfur mustard: bis(2-chloroethyl)sulfide
as listed within Schedule 1.A.04 under
CAS 505-60-2

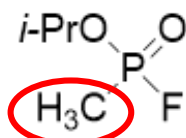
ISOTOPES

Just to complicate things more:

Hydrogen isotopes are written in chemical structures as: H (^1H), D (^2H) or T (^3H)



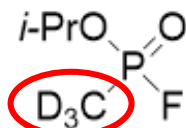
Isotopically
under t



sarin

Schedule 1.A.01

CAS 107-44-8



sarin-*d*₃

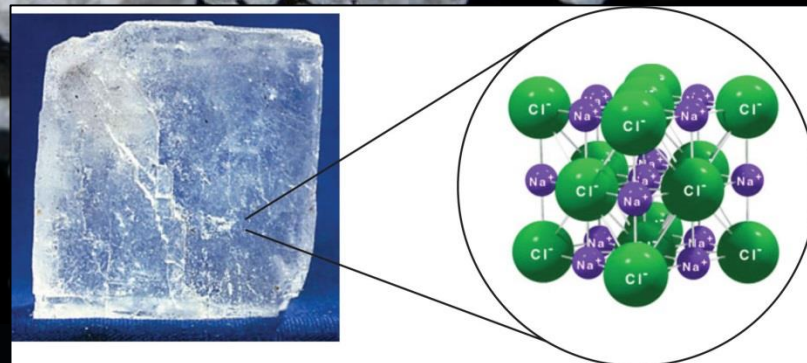
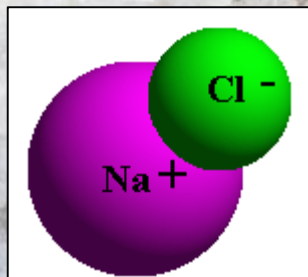
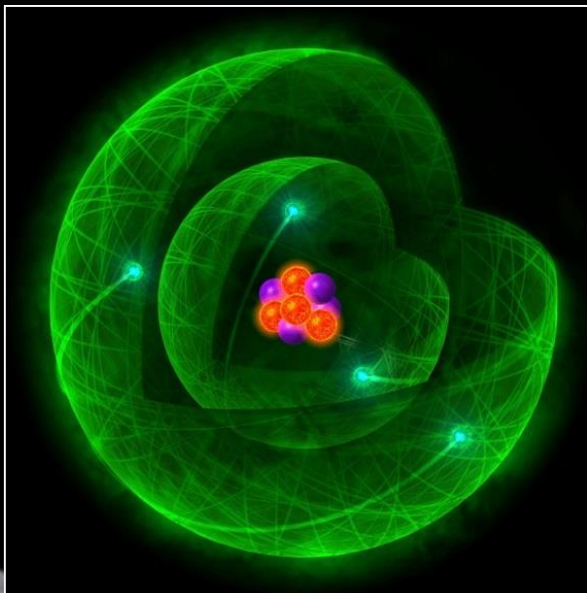
CAS 104801-08-3

fall
bound

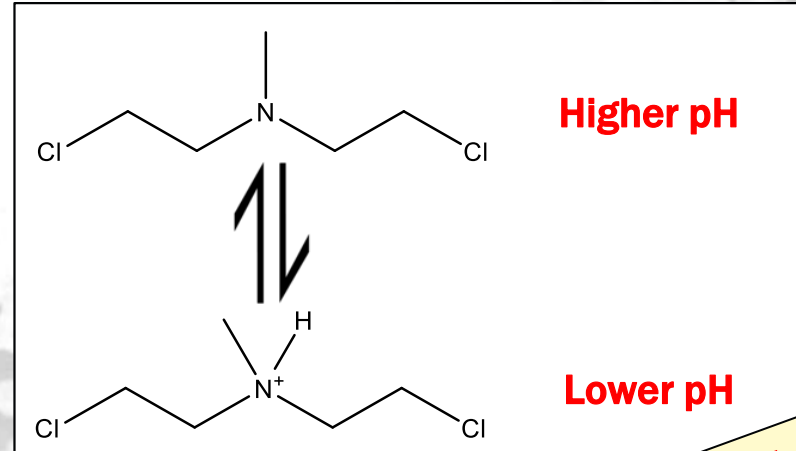
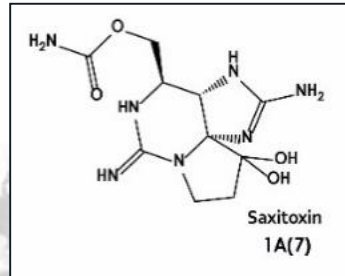
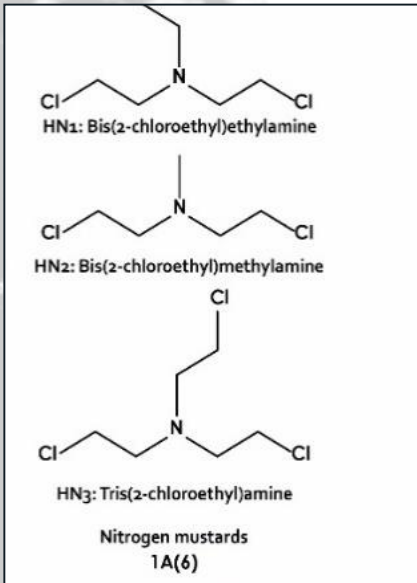
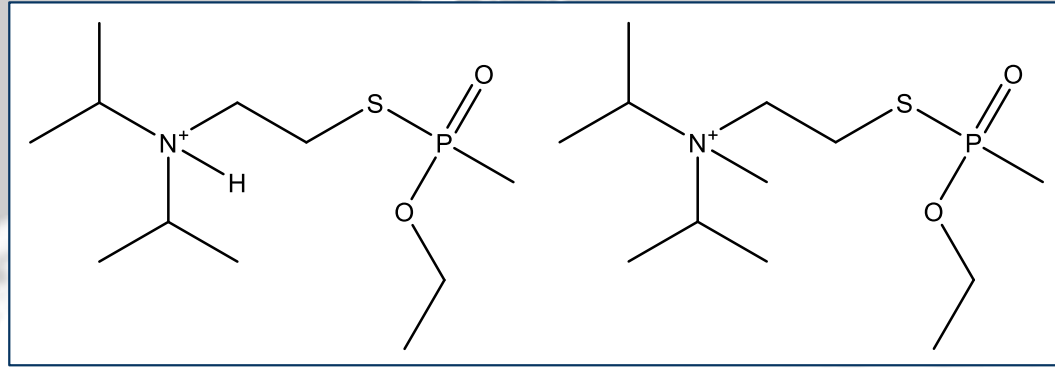
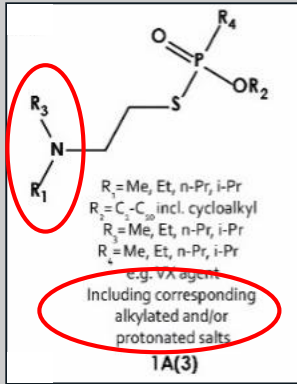
(...)/sulfide
e 1.A.04 under

S 6755-76-6

Salts?



Why Does This Matter?



Are salts of 1A.04 and 1A.07 chemicals scheduled?

Should salts of scheduled chemicals not specified on the schedules be scheduled?



**The Number of Scheduled
Chemicals is Limitless...**



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**~32,000 CAS numbers assigned
to Scheduled Chemicals**

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Chemicals

Ordered by Schedule and by CAS Registry Number or Key

Chemical name: 1-Isobutyl-3-methylbutyl isopropylphosphonofluoridate

Schedule: 1A01

CAS RN:

HS code: 2931.39

Key: (108-82-7)-1A1

Molecular formula: C₁₂H₂₆FO₂P

CAS Index Name: Phosphonofluoric acid, 1-methylethyl-, 1-isobutyl-3-methylbutyl ester

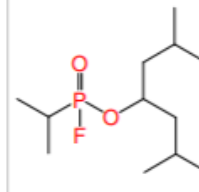
IUPAC name: 1-Isobutyl-3-methylbutyl isopropylphosphonofluoridate

Synonyms: Phosphonofluoric acid, 1-methylethyl-, 2,6-dimethylhept-4-yl ester

O-1-Isobutyl-3-methylbutyl isopropylphosphonofluoridate

2,6-Dimethylheptan-4-yl 1-methylethylphosphonofluoridate

2,6-Dimethylhept-4-yl 1-methylethylphosphonofluoridate



Chemical name: 1-Isobutyl-3-methylbutyl propylphosphonofluoridate

Schedule: 1A01

CAS RN:

HS code: 2931.39

Key: (108-82-7)-1A1

Molecular formula: C₁₂H₂₆FO₂P

CAS Index Name: Phosphonofluoric acid, propyl-, 1-isobutyl-3-methylbutyl ester

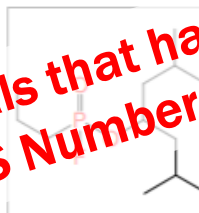
IUPAC name: 1-Isobutyl-3-methylbutyl propylphosphonofluoridate

Synonyms: Phosphonofluoric acid, propyl-, 2,6-dimethylhept-4-yl ester

O-1-Isobutyl-3-methylbutyl propylphosphonofluoridate

2,6-Dimethylheptan-4-yl propylphosphonofluoridate

2,6-Dimethylhept-4-yl propylphosphonofluoridate



Chemical name: Cyclohexyl methyl-d₃-phosphonofluoridate

Schedule: 1A01

CAS RN:

HS code: 2845.90

Key: (108-93-6)-1A1(D3)

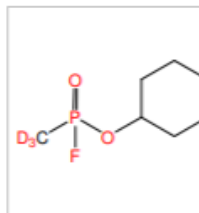
Molecular formula: C₇H₁₁D₃FO₂P

CAS Index Name: Phosphonofluoric acid, methyl-d₃-, cyclohexyl ester

IUPAC name: Cyclohexyl methyl-d₃-phosphonofluoridate

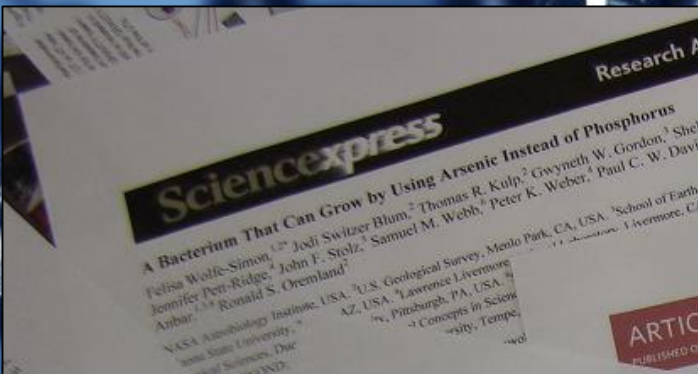
Synonyms: O-Cyclohexyl trideuteriomethylphosphonofluoridate

O-Cyclohexyl methyl-d₃-phosphonofluoridate



Handbook on Chemicals 2017 Revised version 1

www.opcw.org/our-work/non-proliferation/declarations-adviser/handbook-on-chemicals/



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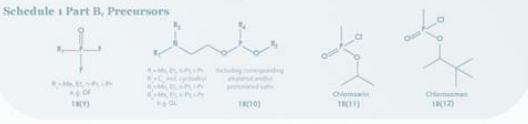
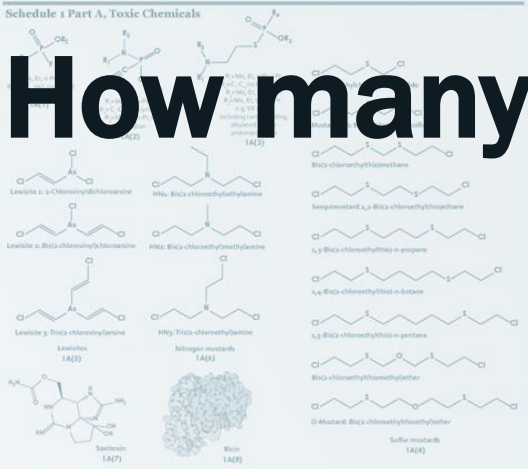
~32,000 CAS numbers assigned to Scheduled Chemicals

What About Chemicals Not on Schedules?

Schedule 1

Guidelines for Schedule 1
 The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

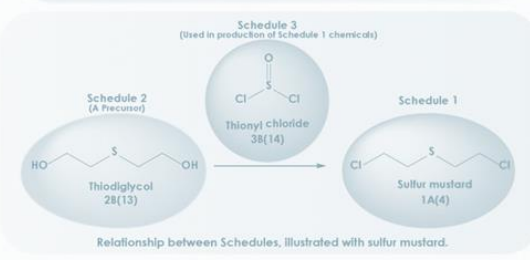
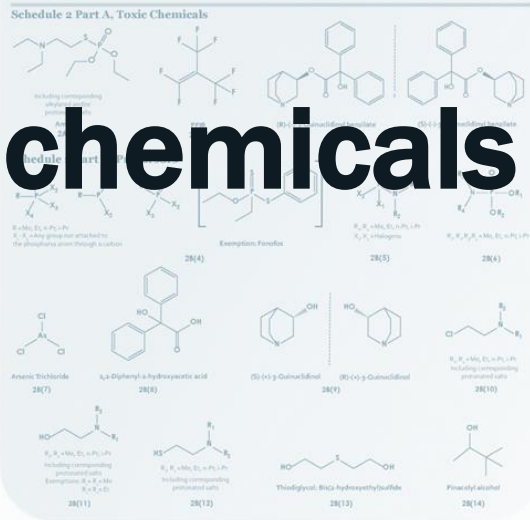
- It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention by virtue of its high potential for use in activities prohibited under this Convention because one or more of the following conditions are met:
 - It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, comparable properties;
 - It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon; It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;
 - It has little or no use for purposes not prohibited under this Convention.



Schedule 2

Guidelines for Schedule 2
 The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:

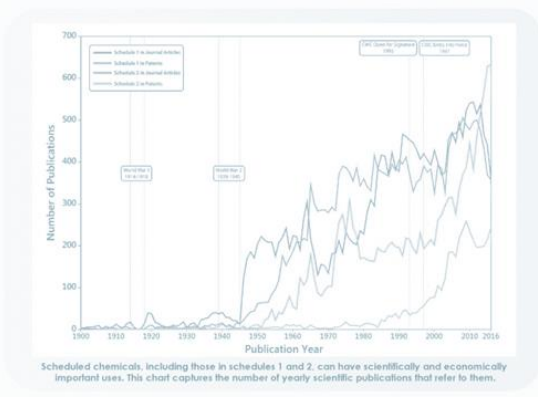
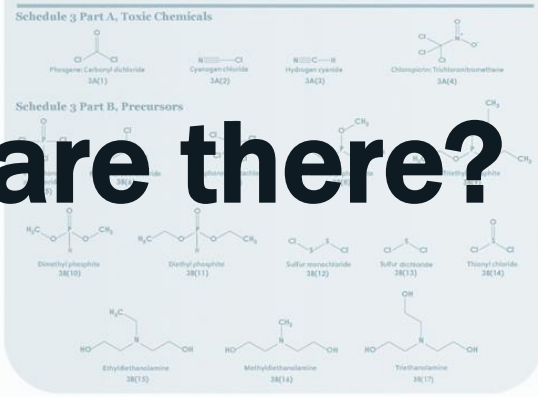
- It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
- It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2, part A;
- It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A;
- It is not produced in large commercial quantities for purposes not prohibited under this Convention.



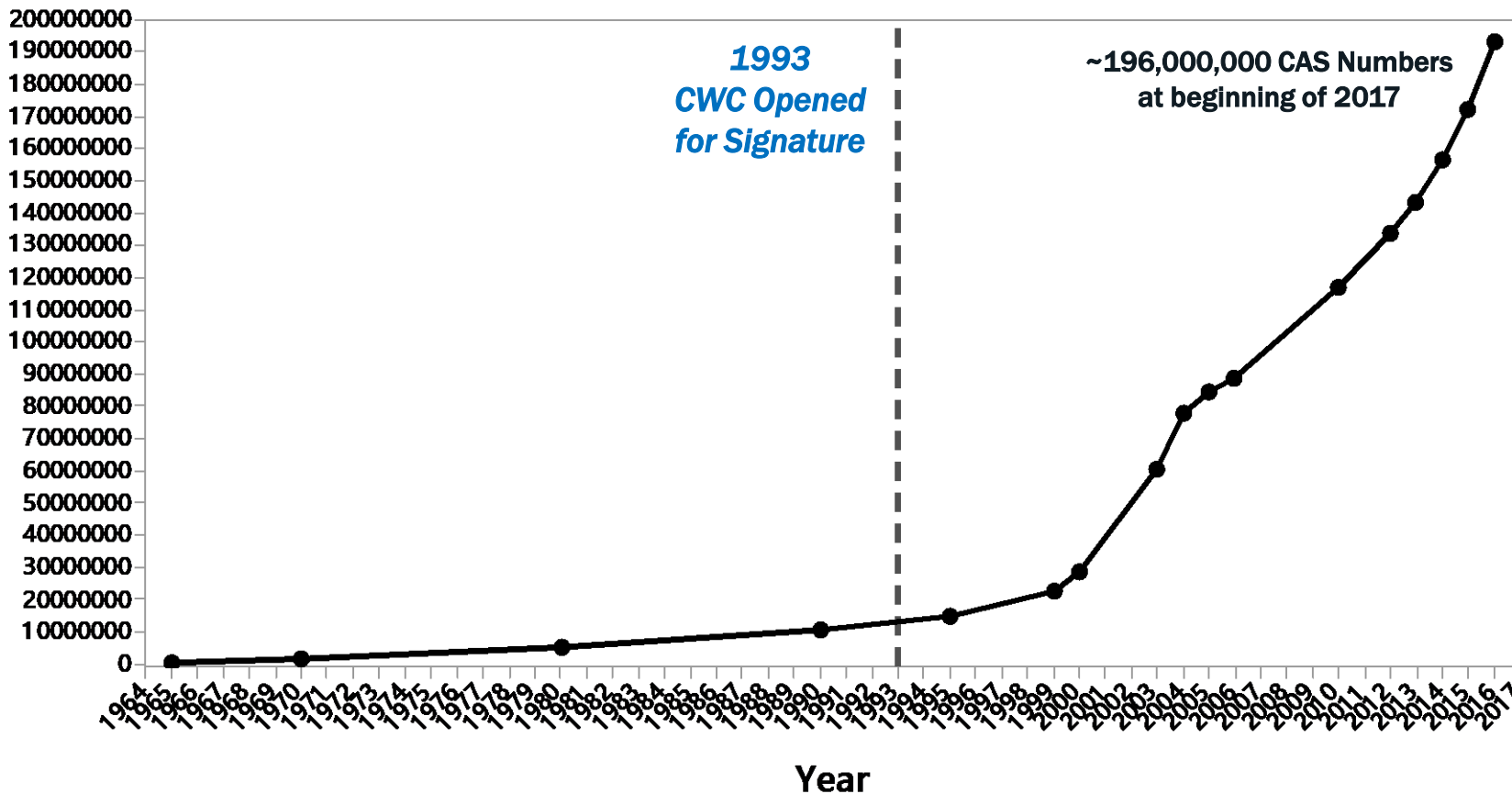
Schedule 3

Guidelines for Schedule 3
 The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- It has been produced, stockpiled or used as a chemical weapon;
- It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that might enable it to be used as a chemical weapon;
- It poses a risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part B;
- It may be produced in large commercial quantities for purposes not prohibited under this Convention.



CAS Registry Numbers
(chemical substances and sequences)



SCANNING SPACE...

- > 209 Million CAS Numbers as of July 2018..
- > 142 Million are organic/inorganic chemical substances
- > 13 million new CAS numbers in past 18 months...

What About Chemicals Not on Schedules?

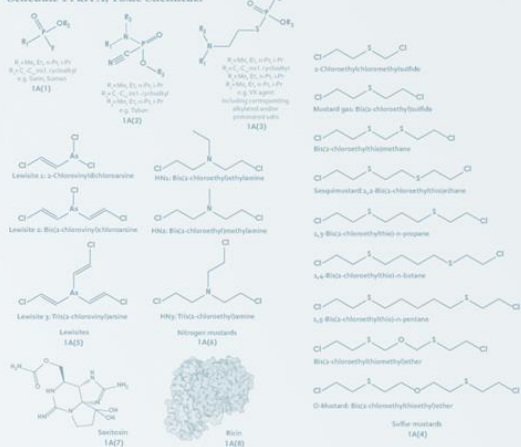
Schedule 1

Guidelines for Schedule 1

The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention by virtue of its potential for use in activities prohibited under this Convention, or its use in such activities might be facilitated by its possession, production, stockpiling or use, as other properties that it possesses such as its lethality or incapacitating toxicity;
- It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon; It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;
- It has little or no use for purposes not prohibited under this Convention.

Schedule 1 Part A, Toxic Chemicals



Schedule 1 Part B, Precursors



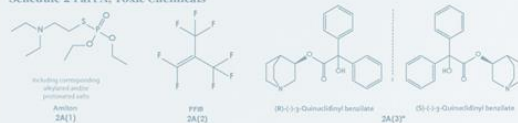
Schedule 2

Guidelines for Schedule 2

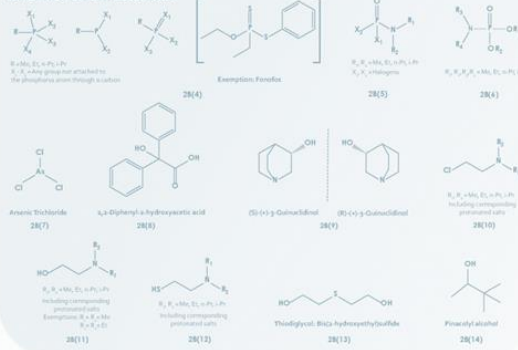
The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:

- It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
- It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon; It may be used as a precursor in the final single technological stage of production of a chemical listed in Schedule 1 or Schedule 2, part A;
- It is not produced in large commercial quantities for purposes not prohibited under this Convention.

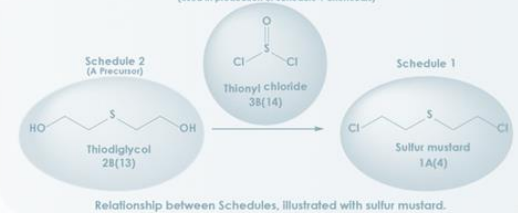
Schedule 2 Part A, Toxic Chemicals



Schedule 2 Part B, Precursors



Schedule 3 (Used in production of Schedule 1 chemicals)



Schedule 3

Guidelines for Schedule 3

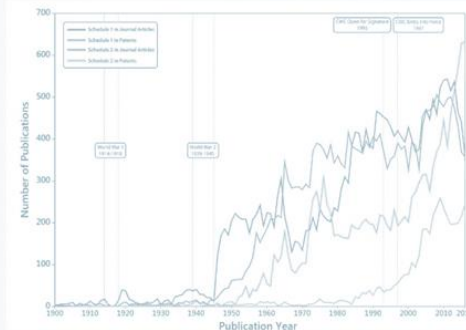
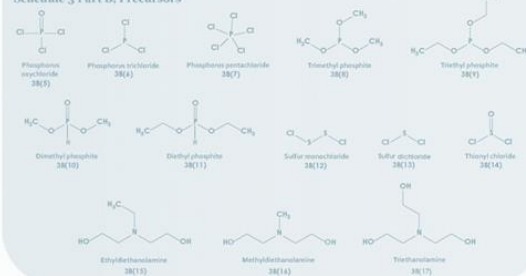
The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- It has been produced, stockpiled or used as a chemical weapon;
- It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that it possesses such as its lethality or incapacitating toxicity;
- It is produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 3 Part A, Toxic Chemicals



Schedule 3 Part B, Precursors



Scheduled chemicals, including those in schedules 1 and 2, can have scientifically and economically important uses. This chart captures the number of yearly scientific publications that refer to them.



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Answers from the Audience

Schedule 1

Schedule 2

Schedule 3

Which unscheduled chemicals matter?

Mentimeter

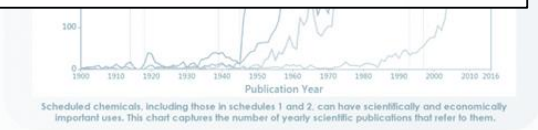
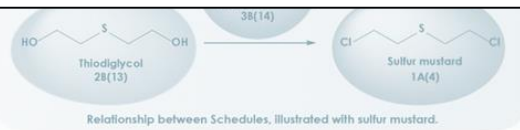


14



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What About Chemicals Not on Schedules?

Schedule 1

Guidelines for Schedule 1

The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention by virtue of its potential for use in activities prohibited under this Convention, or because it is a precursor of such a chemical or because it is a chemical listed in Schedule 2 and has, or can be expected to have, comparable properties;
- It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon; or
- It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 3, regardless of

Schedule 2

Guidelines for Schedule 2

The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:

- It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon; or
- It is a precursor of a chemical listed in Schedule 1 or of a chemical listed in Schedule 2, part A, and its production is of such importance to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A; or
- It is not produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 3

Guidelines for Schedule 3

The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- It has been produced, stockpiled or used as a chemical weapon;
- It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon; or
- It is a precursor of a chemical listed in Schedule 1 or of a chemical listed in Schedule 2, part B; or
- It may be produced in large commercial quantities for purposes not prohibited under this Convention.

Which unscheduled chemicals matter?

The Definition of a Toxic Chemical

Any chemical which through its chemical action on life processes can cause death, temporary incapacitation or permanent harm to humans or animals. ***This includes all such chemicals, regardless of their origin or of their method of production***, and regardless of whether they are produced in facilities, in munitions or elsewhere

Chemical Weapons Convention Article II, Paragraph 2



PROHIBITION OF CHEMICAL WEAPONS

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Thiodiglycol
2B(13)

Sulfur mustard
1A(4)

Relationship between Schedules, illustrated with sulfur mustard.



Scheduled chemicals, including those in schedules 1 and 2, can have scientifically and economically important uses. This chart captures the number of yearly scientific publications that refer to them.



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Riot Control Agents

Fauzia Nurul Izzati, Jonathan E. Forman and Christopher M. Timperley

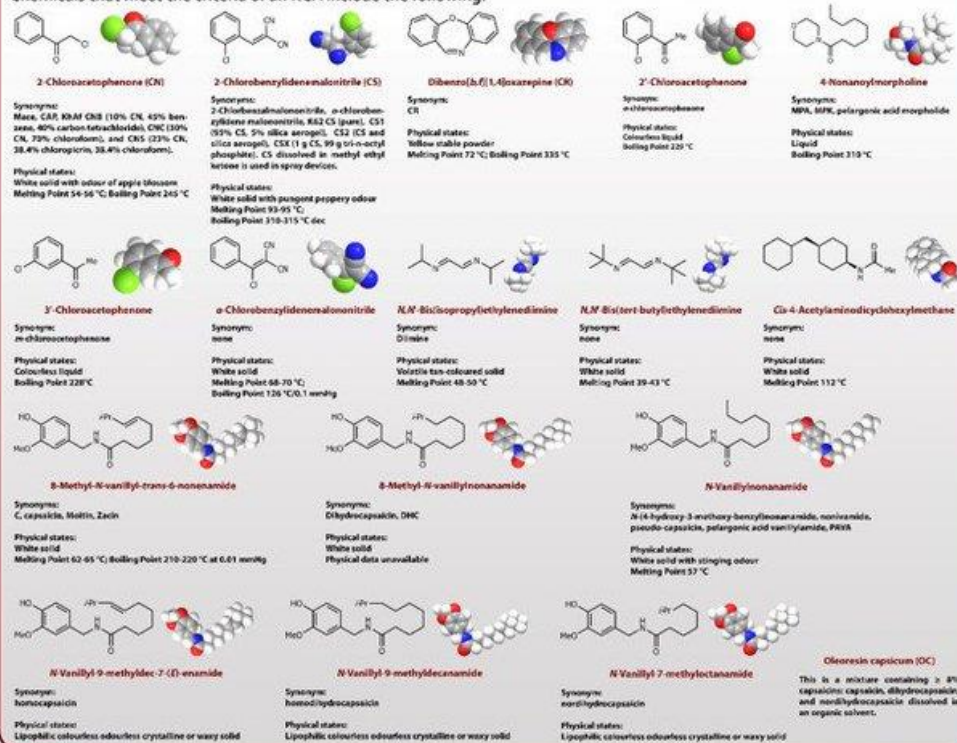
What is the definition of a Riot Control Agent (RCA)?

From paragraph 7, Article II of the Chemical Weapons Convention:

"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."

What are Riot Control Agents?

Chemicals that meet the criteria of an RCA include the following:



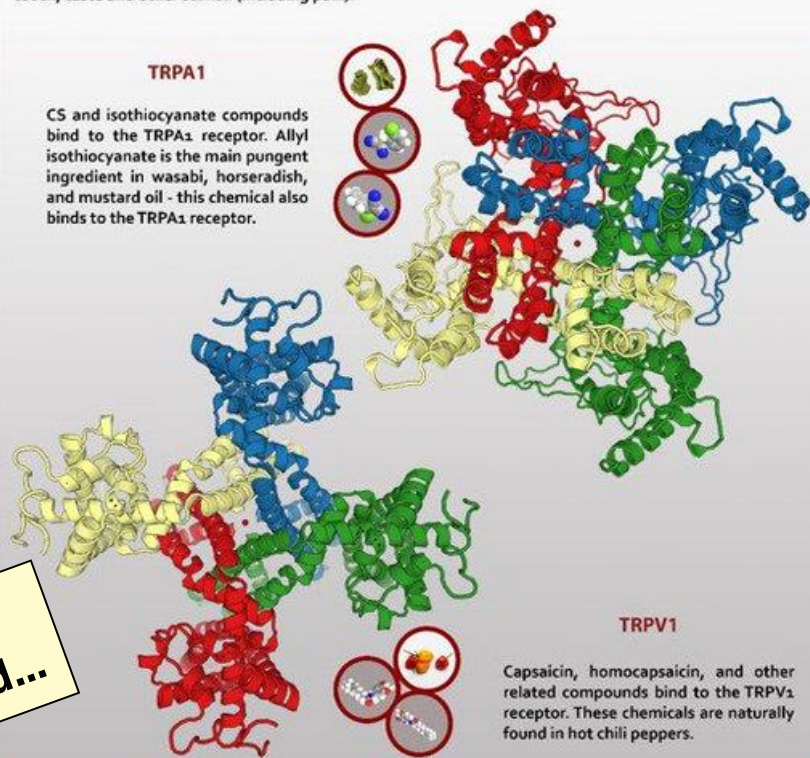
How do Riot Control Agents work?

RCAs produce irritation through binding to TRP (Transient Receptor Potential) receptors. This activates some of the same biochemical pathways that are triggered by eating horseradish or hot peppers.

What are TRP Receptors?

TRP receptors are a family of ion channel receptors mainly located on cell membranes of multicellular organisms. TRP receptors are classified into seven subfamilies: TRPC (canonical or classical), TRPV (vanilloid), TRPM (melastatin), TRPA (ANKTM1 homologues), TRPP (polycystin), TRPML (mucolipin), and TRPN (NOMP-C homologues).

TRP receptor functions are diverse; the receptors serve as versatile sensors that allow individual cells and entire organisms to detect changes in their environment. This includes experiencing changes in temperature, touch, taste and other stimuli (including pain).



Riot Control Agents
Cannot be Scheduled...



Toxic Industrial Chemicals

TICs listed by hazard index

High	Medium	Low
Ammonia (CAS# 7664-41-7)	Acetone cyanohydrin (CAS# 75-86-5)	Allyl isothiocyanate (CAS# 57-06-7)
Arsine (CAS# 7784-42-1)	Acrolein (CAS# 107-02-8)	Arsenic trichloride (CAS# 7784-34-1)
Boron trichloride (CAS#10294-34-5)	Acrylonitrile (CAS# 107-13-1)	Bromine (CAS# 7726-95-6)
Boron trifluoride (CAS#7637-07-2)	Allyl alcohol (CAS# 107-18-6)	Bromine chloride (CAS# 13863-41-7)
Carbon disulfide (CAS# 75-15-0)	Allylamine (CAS# 107-11-9)	Bromine pentafluoride (CAS# 7789-30-2)
Chlorine (CAS# 7782-50-5)	Allyl chlorocarbonate (CAS# 2937-50-0)	Bromine trifluoride (CAS# 7787-71-5)
Diborane (CAS# 19287-45-7)	Boron tribromide (CAS# 10294-33-4)	Carbonyl fluoride (CAS# 353-50-4)
Ethylene oxide (CAS# 75-21-8)	Carbon monoxide (CAS# 630-08-0)	Chlorine pentafluoride (CAS# 13637-63-3)
Fluorine (CAS# 7782-41-4)	Carbonyl sulfide (CAS# 463-58-1)	Chlorine trifluoride (CAS# 7790-91-2)
Formaldehyde (CAS# 50-00-0)	Chloroacetone (CAS# 78-95-5)	Chloroacetaldehyde (CAS# 107-20-0)
Hydrogen bromide (CAS# 10035-10-6)	Chloroacetonitrile (CAS# 7790-94-5)	Chloroacetyl chloride (CAS# 79-04-9)
Hydrogen chloride (CAS# 7647-01-0)	Chlorosulfonic acid (CAS# 7790-94-5)	Crotonaldehyde (CAS# 123-73-9)
Hydrogen cyanide (CAS#74-90-8)	Diketene (CAS# 674-82-8)	Cyanogen chloride (CAS# 506-77-4)
Hydrogen fluoride (CAS# 7664-39-3)	1,2-Dimethylhydrazine (CAS# 540-73-8)	Dimethyl sulfate (CAS# 77-78-1)
Hydrogen sulfide (CAS# 7783-0604)	Ethylene dibromide (CAS# 106-93-4)	Diphenylmethane-4,4'-diisocyanate (CAS# 101-68-8)
Nitric acid, fuming (CAS# 7697-37-2)	Hydrogen selenide (CAS# 7783-07-5)	Ethyl chloroformate (CAS# 541-41-3)
Phosgene (CAS# 75-44-5)	Methanesulfonyl chloride (CAS# 124-63-0)	Ethyl chlorothioformate (CAS# 2941-64-2)

⋮

Some are
scheduled

⋮

⋮

	n-Octyl mercaptan (CAS# 111-88-6)	Tetraethyl lead (CAS# 78-00-2)
	Titanium tetrachloride (CAS# 7550-45-0)	Tetraethyl pyrophosphate (CAS# 107-49-3)
	Trichloroacetyl chloride (CAS# 76-02-8)	Tetramethyl lead (CAS# 75-74-1)
	Trifluoroacetyl chloride (CAS# 354-32-5)	Toluene 2,4-diisocyanate (CAS# 584-84-9)
		Toluene 2,6-diisocyanate (CAS# 91-08-7)

<https://www.osha.gov/SLTC/emergencypreparedness/guides/chemical.html>



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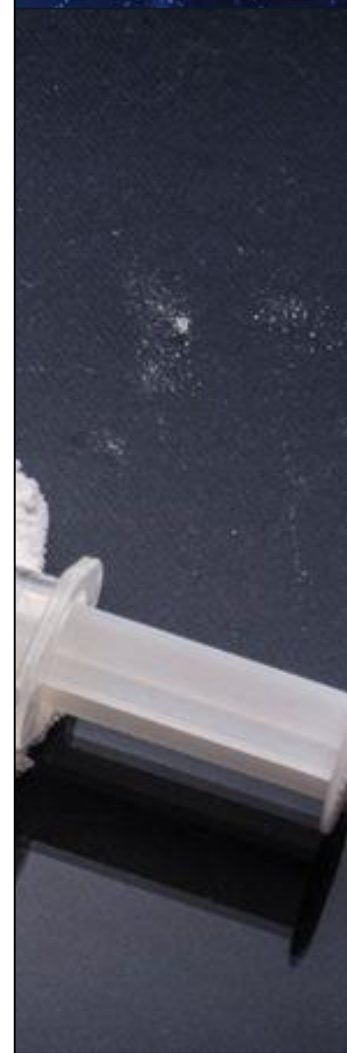
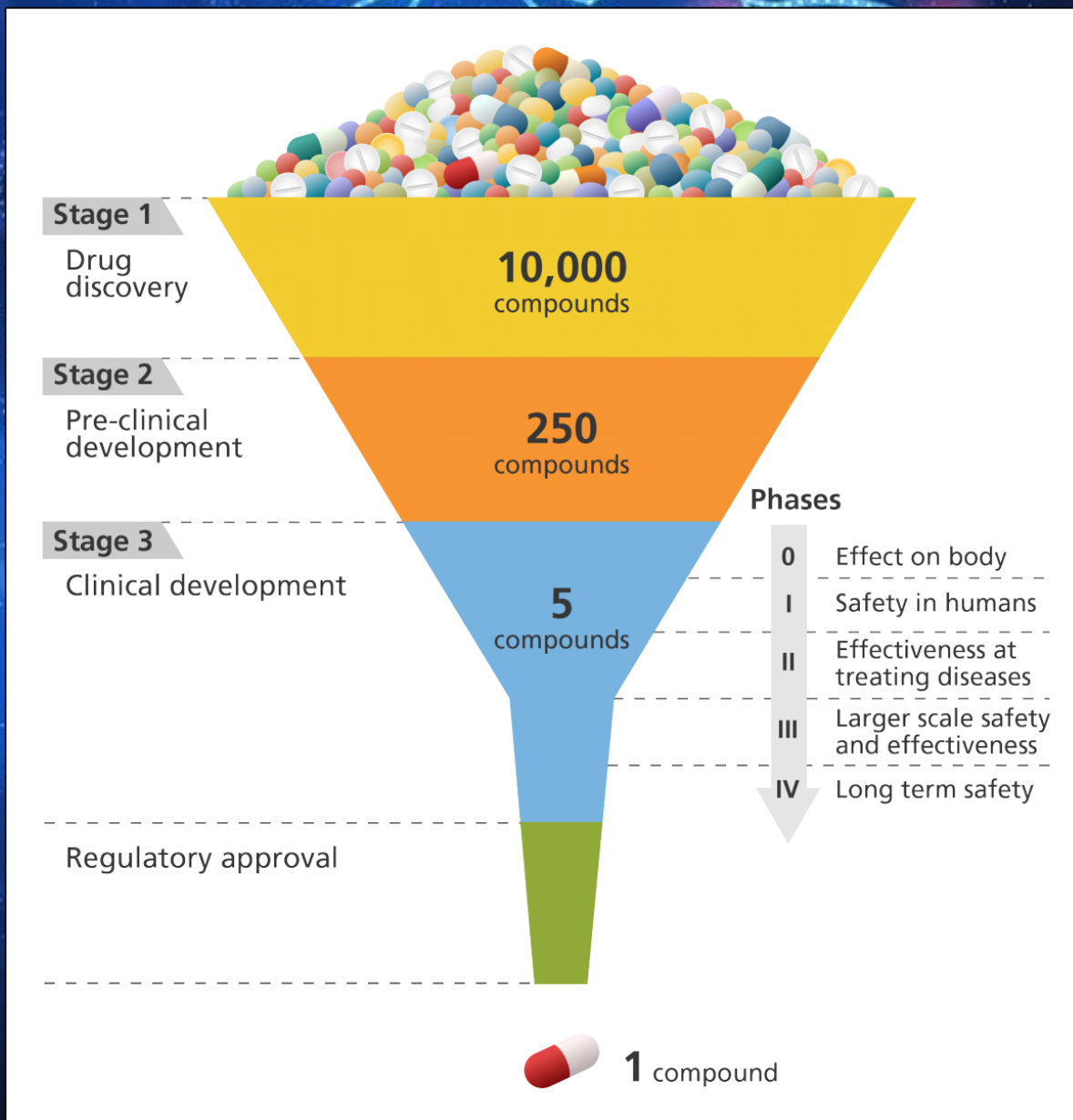
Central Nervous System Acting Chemicals



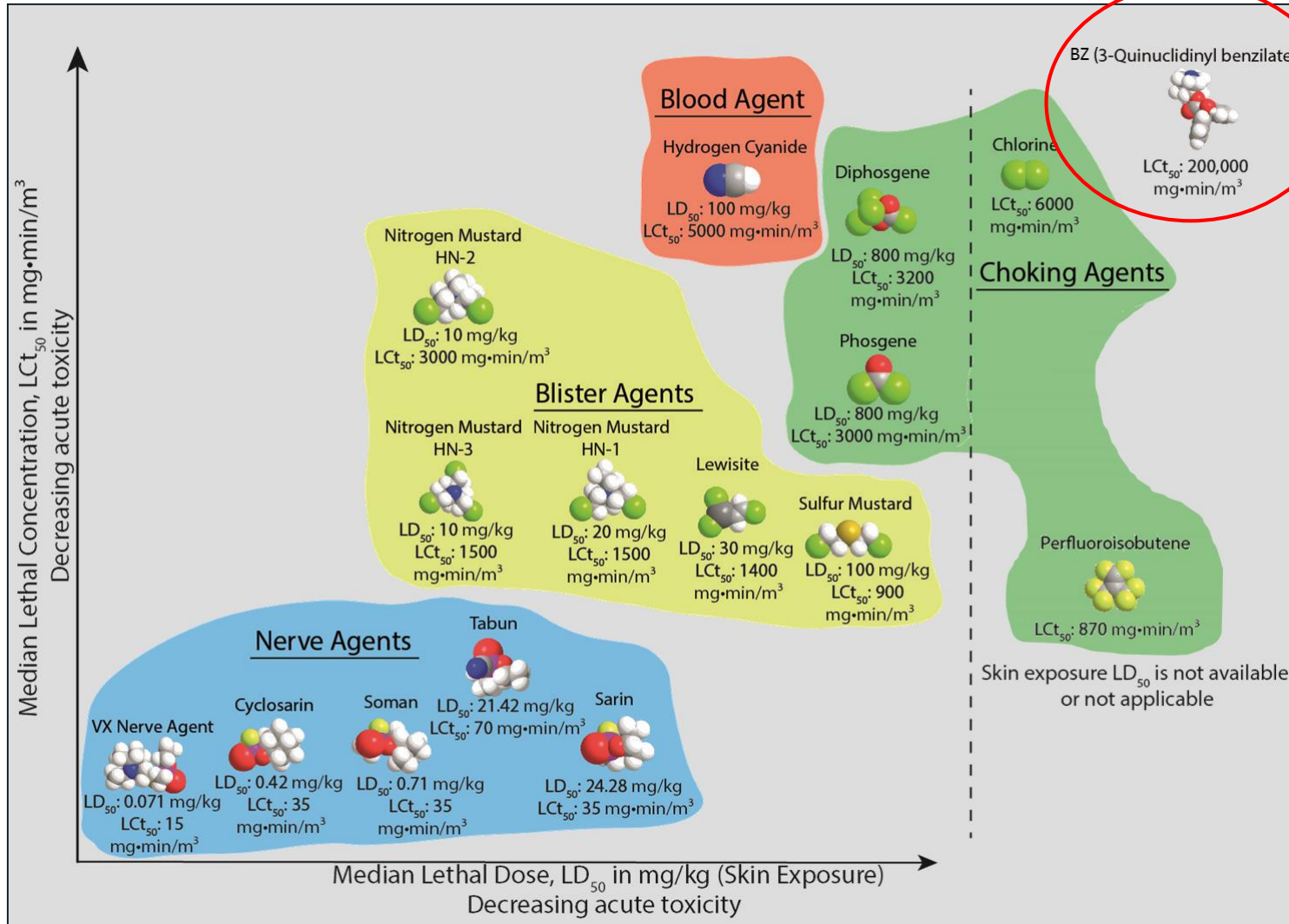
Central Nervous System Acting Chemicals



Central Nervous System Acting Chemicals

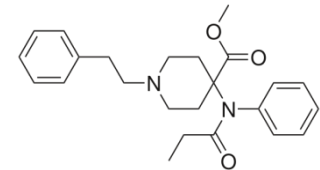


Relative Toxicity?



Can be lower than other CW

Can also be very high!

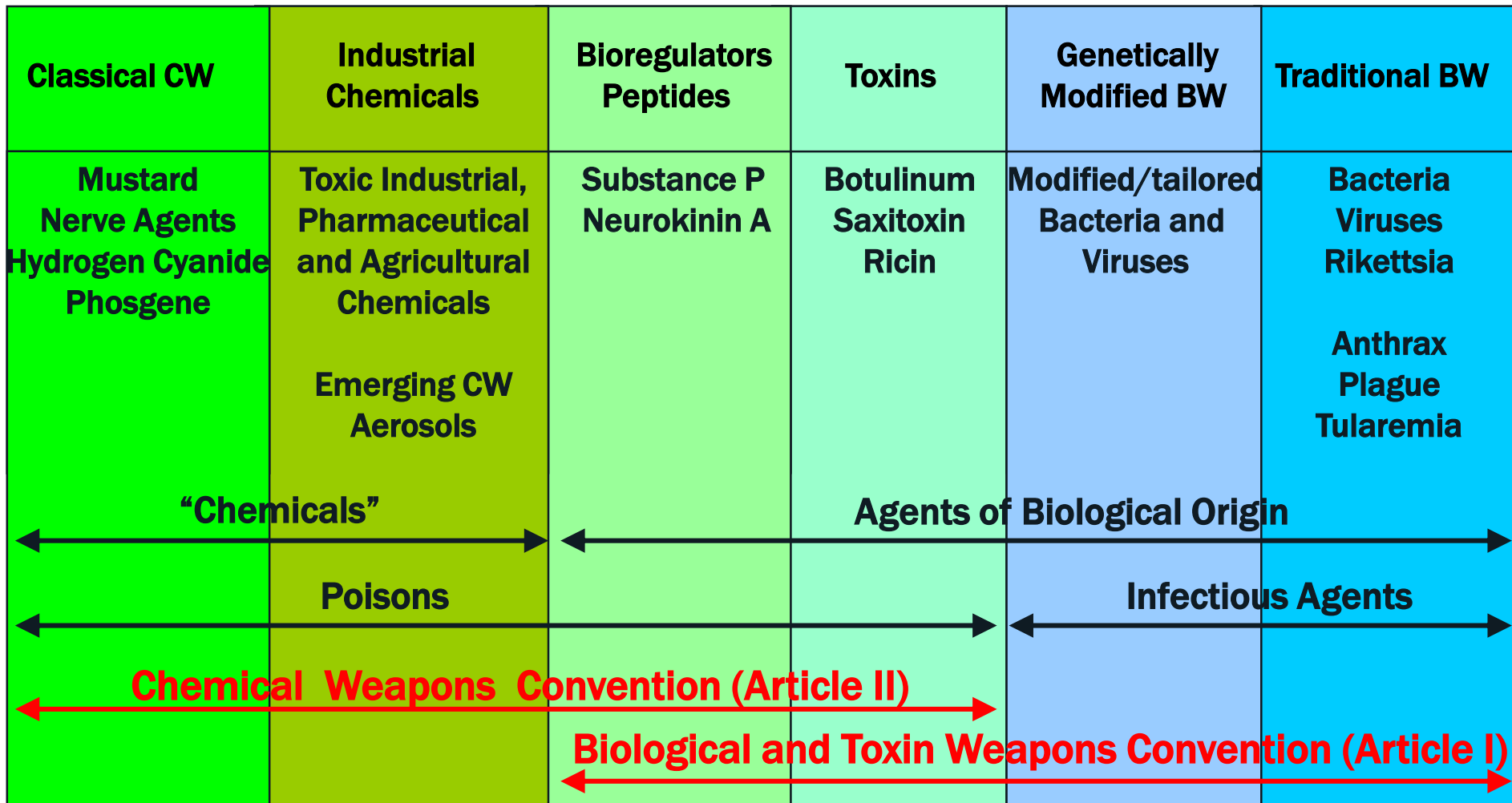


e.g. Carfentanil



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Chemical – Biological Threat Spectrum



Adopted from Graham S Pearson, ASA Newsletter, 90-1, February 1990 and Robert Mathews at TWG on Convergence. 1st Meeting 2011



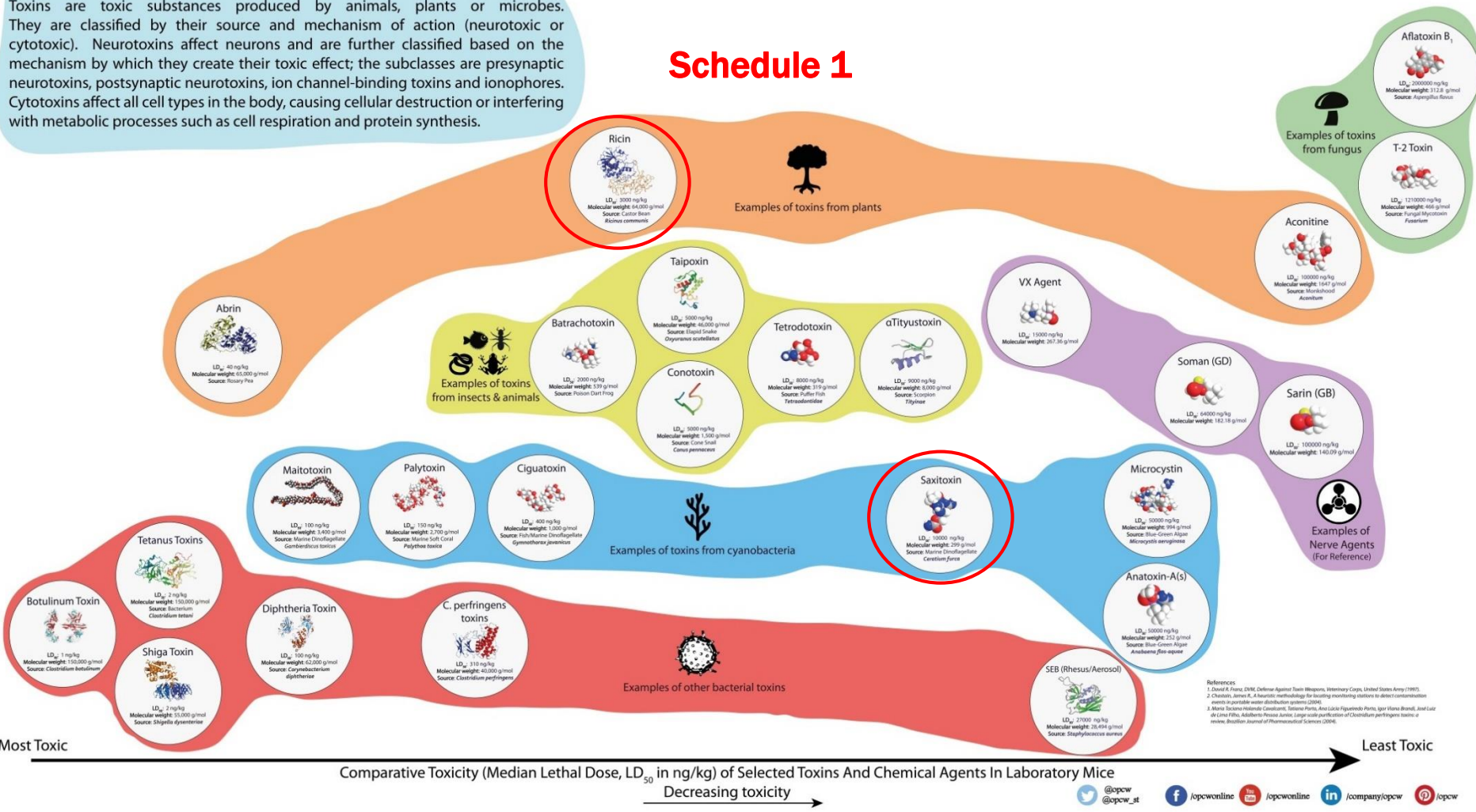
OPCW

Toxins

What are Toxins?

Toxins are toxic substances produced by animals, plants or microbes. They are classified by their source and mechanism of action (neurotoxic or cytotoxic). Neurotoxins affect neurons and are further classified based on the mechanism by which they create their toxic effect; the subclasses are presynaptic neurotoxins, postsynaptic neurotoxins, ion channel-binding toxins and ionophores. Cytotoxins affect all cell types in the body, causing cellular destruction or interfering with metabolic processes such as cell respiration and protein synthesis.

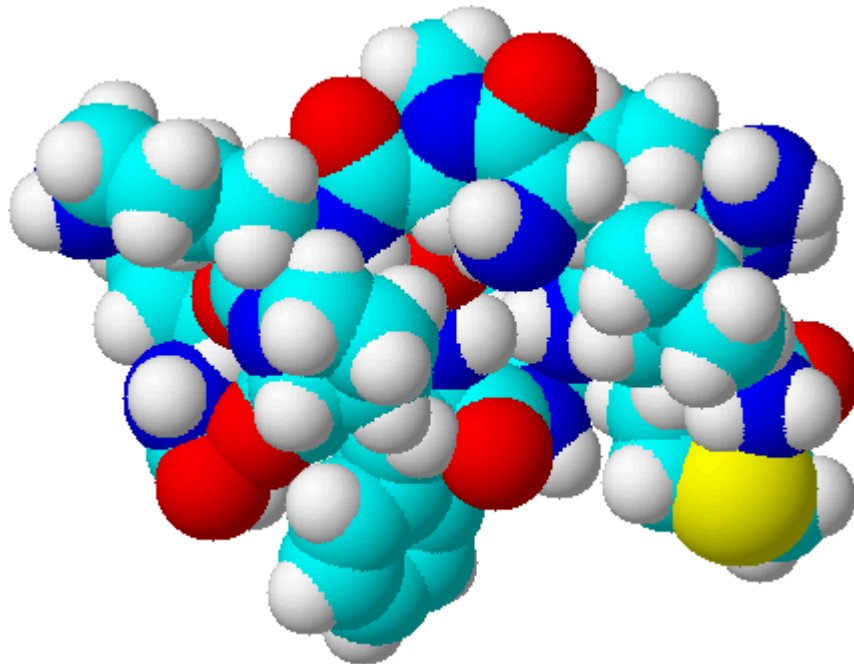
Schedule 1



References:
 1. David F. Francis, DVM, Defense Against Twin Weapons, Veterinary Corps, United States Army (1995).
 2. Chavakis, Armin, et al. A neuron-microbiology for locating monitoring stations to detect contamination events in portable water distribution systems (2006).
 3. Maria Dolores Palencia-Castellano, Teresa Porto, Ana Lucia Figueroa Porto, Igor Vilas Brandi, and Luis de Cidre Eche, Antibiotic-Resistant, Large-scale purification of Clostridium perfringens toxin a review. Brazilian Journal of Pharmaceutical Sciences (2006).

Bioregulators

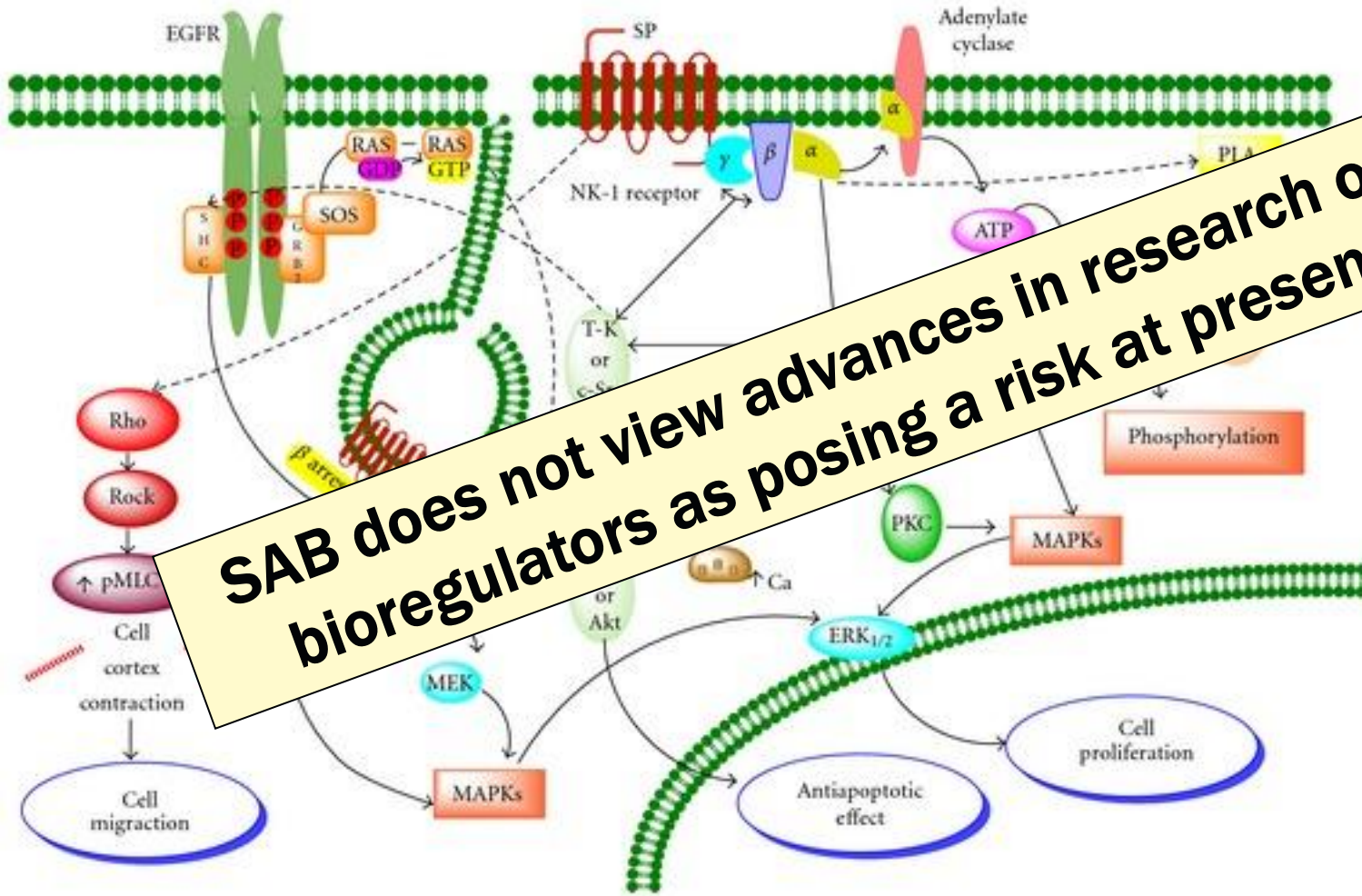
- Endogenous molecules that regulate life processes...



Substance P (pain modulation)



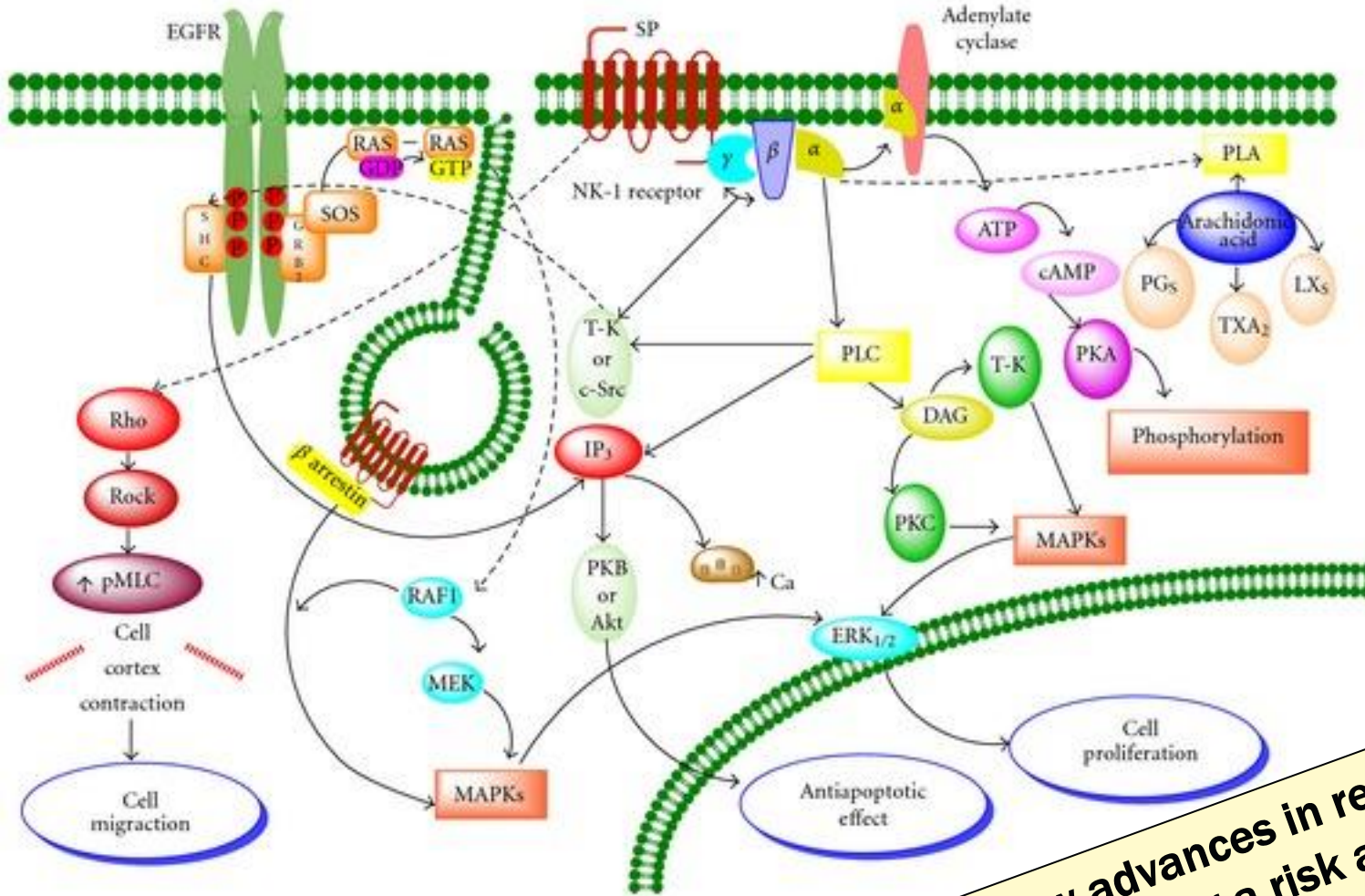
Bioregulators



SAB does not view advances in research on bioregulators as posing a risk at present



Bioregulators



SAB does not view advances in research on bioregulators as posing a risk at present



Unscheduled Chemicals that Pose a Risk to the Convention?



OPCW

Recent Advice from the Scientific Advisory Board

S/1621/2018
Annex
page 2

Annex

DIRECTOR-GENERAL'S REQUEST TO THE SCIENTIFIC ADVISORY BOARD TO PROVIDE ADVICE ON NEW TYPES OF NERVE AGENTS

1. Recent events involving the use of nerve agents against individuals in Malaysia and Great Britain and Northern Ireland have drawn considerable attention, including in the scientific community. While the Malaysia ill-known V-series nerve agent, the incident in the United Kingdom involved a highly toxic nerve agent with a structure that has appeared in the past but has never been declared under the Chemical Weapons Convention. In the United Kingdom incident, no information has been published in the scientific literature.

Over the past many years, a wide range of types of nerve agents have been developed as weapons based on many years among experts outside the OPCW.¹ The SAB has included organophosphorus structures that would fall under the Convention's Annex on Chemicals, as well as related structures that would not belong to any of the current schedules. The incident from the United Kingdom is not included in the result of the incident in the United Kingdom, articles are now appearing in society membership publications² and journals³ speculating on the uses of the chemical used and other related chemicals that have developed as nerve agents. These publications have broadened the

range of new types of toxic chemicals to the Convention and the re-emergence of chemical weapons, a clear, factual basis for future discussions. Information is necessary as background for States Parties of possible measures to address the potential threat of chemical weapons.

of the report of the Scientific Advisory Board at its Sixteenth Session (1) www.opcw.org/fileadmin/OPCW/SAB/en/sab-16-01_e.pdf (2) *Association for the Advancement of Science*; R. Stone, *Science*, 2018, *in press* arXiv:1804.03444; <http://www.sciencemag.org/news/2018/03/uk-attack-chinese-developed-soviet-scientists>. (b) American Chemical Society: M. Peplow, *ACS*, 2018, 3; <https://cen.acs.org/articles/96/i12/Nerve-agent-attack-on-spy-used>. (c) The Royal Society of Chemistry: E. Stoye, *Chemistry World*, www.chemistryworld.com/news/newsroom-news/uk-nerve-agent-linked-to-chinese (d) The University of Melbourne: G. Braiberg, *Parasitology*, <http://www.unimelb.edu.au/articles/the-science-behind-navy-job>. (e) German *Chem. Unserer Zeit*, 2018, 52, 71; <https://doi.org/10.1002/cituz.201870202>. (f) H. Machado, M. Mitchell, *ACS Chem. Neurosci.*, 2018, Just Accepted schemeuro.8b00148.



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Technical Secretariat

S/1621/2018
2 May 2018
ENGLISH only

NOTE BY THE DIRECTOR-GENERAL

REQUEST FOR INFORMATION FROM STATES PARTIES ON NEW TYPES OF NERVE AGENTS

1. In view of the findings of the March 2018 technical assistance visit requested by the United Kingdom of Great Britain and Northern Ireland (TAV/02/18),¹ the Director-General has tasked the Scientific Advisory Board (SAB) with providing advice on toxic chemicals that have been identified as, or are suspected of being, new types of nerve agents. The SAB is currently working on this request and intends to issue a report and brief States Parties before the Eighty-Eighth Session of the Executive Council. The full text of the request is contained in the Annex to this Note.
2. The Director-General requests States Parties in a position to do so to make available, by the end of May 2018, any information that could assist the SAB in its work.
3. States Parties possessing relevant information that can be provided to the SAB are requested to contact the SAB Secretary (scitech@opcw.org).

Annex: Director-General's Request to the Scientific Advisory Board to Provide Advice on New Types of Nerve Agents

¹ S/1612/2018, dated 12 April 2018.



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Scheduled Chemicals under the Chemical Weapons Convention (CWC)

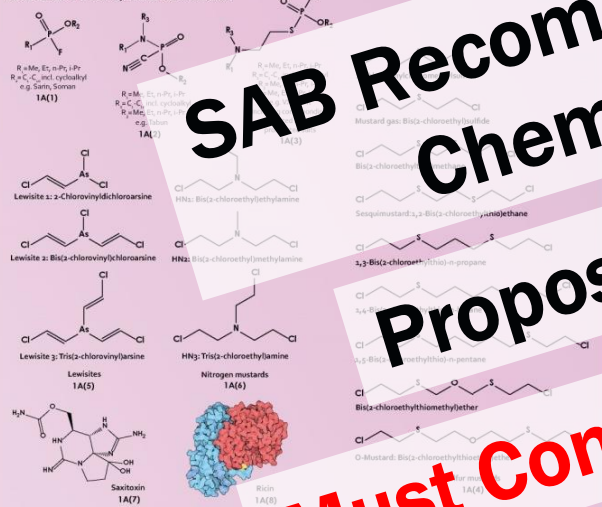
Schedule 1

Guidelines for Schedule 1

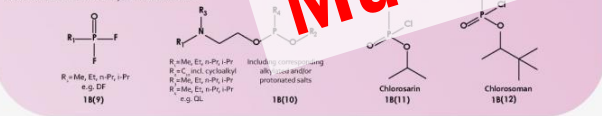
The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- (a) It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;
- (b) It poses otherwise a high risk to the object and purpose of this Convention by virtue of its high potential for use in activities prohibited under this Convention because one or more of the following conditions are met:
 - (i) It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, comparable properties;
 - (ii) It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon;
 - (iii) It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;
- (c) It has little or no use for purposes not prohibited under this Convention.

Schedule 1 Part A, Toxic Chemicals



Schedule 1 Part B, Precursors



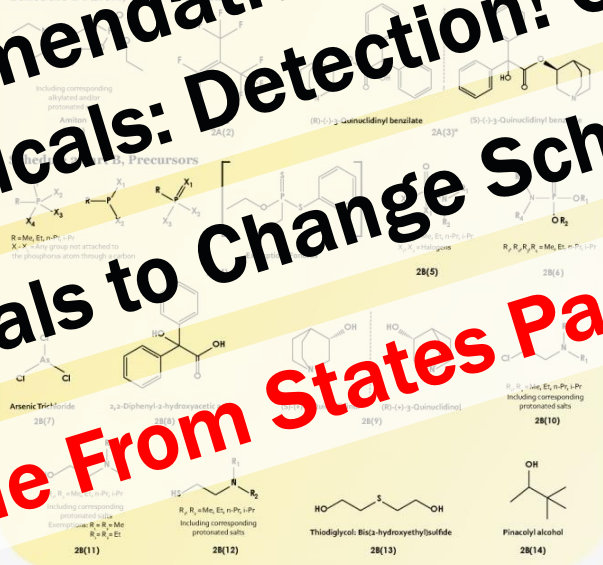
Schedule 2

Guidelines for Schedule 2

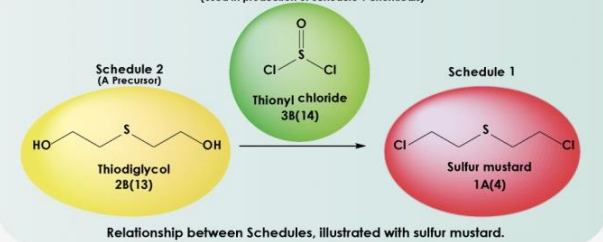
The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:

- (a) It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
- (b) It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2, part A, or in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part A;
- (c) It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A;
- (d) It is not produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 2 Part A, Toxic Chemicals



Schedule 3 (Used in production of Schedule 1 chemicals)



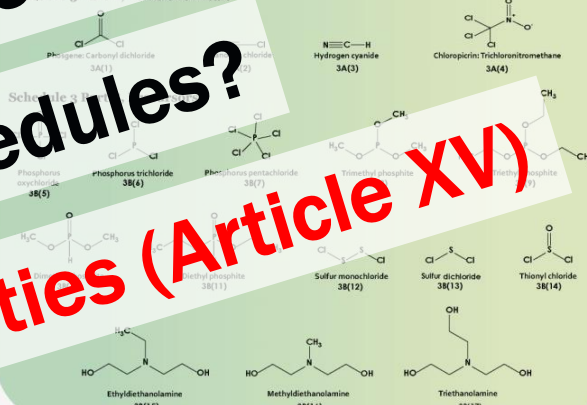
Schedule 3

Guidelines for Schedule 3

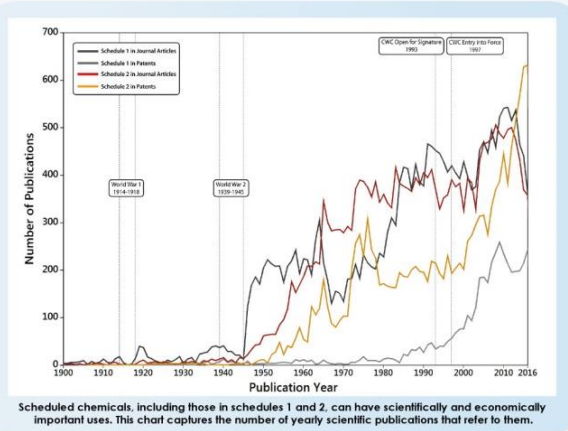
The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in Schedules 1 or 2, should be included in Schedule 3:

- (a) It has been developed, produced, stockpiled or used as a chemical weapon; or
- (b) It poses otherwise a high risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
- (c) It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2, part A, or in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part A;
- (d) It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part A;
- (e) It is not produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 3 Part A, Toxic Chemicals



SAB Recommendations on Unscheduled Chemicals: Detection! OCAD! Must Come From States Parties (Article XV)



Scheduled chemicals, including those in schedules 1 and 2, can have scientifically and economically important uses. This chart captures the number of yearly scientific publications that refer to them.



ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS
Working Together for a World Free of Chemical Weapons

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Scheduled Chemicals under the Chemical Weapons Convention (CWC)

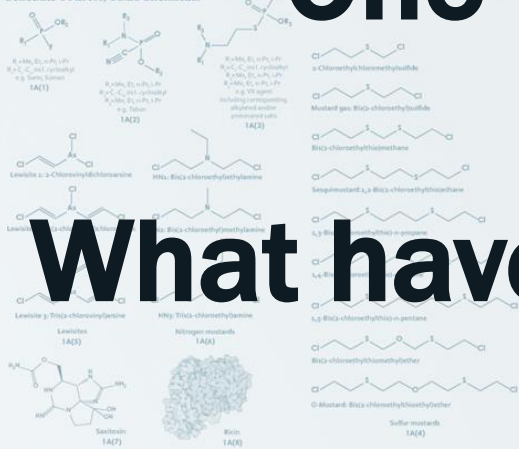
Schedule 1

Guidelines for Schedule 1

The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:

- It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention by virtue of its high potential for use in activities prohibited under this Convention because one or more of the following conditions are met:
 - It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, comparable properties;
 - It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon; or
 - It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in the same conditions or elsewhere;
- It has little or no use for purposes not prohibited under this Convention.

Schedule 1 Part A, Toxic Chemicals



Schedule 1 Part B, Precursors



Schedule 2

Guidelines for Schedule 2

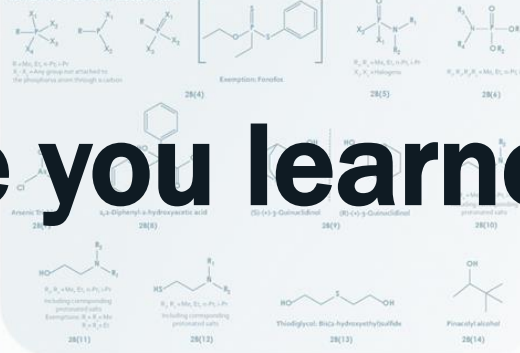
The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:

- It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
- It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2, part A;
- It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A;
- It is not produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 2 Part A, Toxic Chemicals



Schedule 2 Part B, Precursors



Schedule 3

Guidelines for Schedule 3

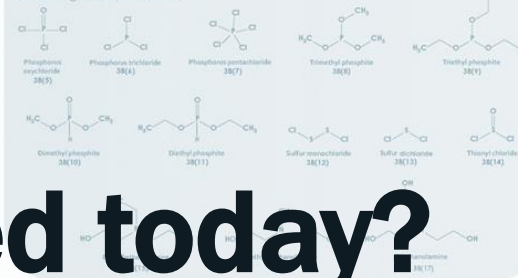
The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:

- It has been produced, stockpiled or used as a chemical weapon;
- It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that might enable it to be used as a chemical weapon;
- It poses a risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part B;
- It may be produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 3 Part A, Toxic Chemicals



Schedule 3 Part B, Precursors



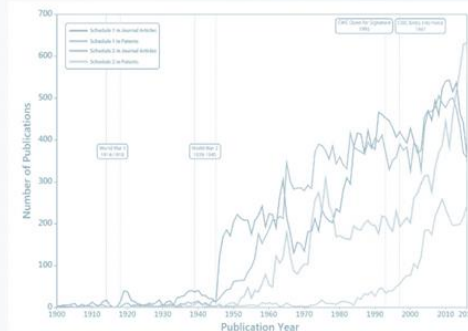
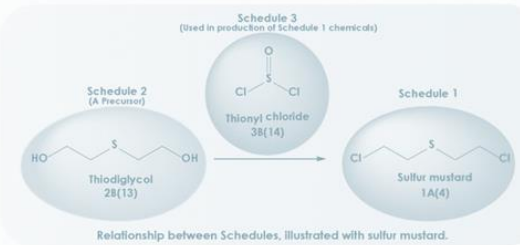
One Last Question...

What have you learned today?



ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Working Together for a World Free of Chemical Weapons



Scheduled chemicals, including those in schedules 1 and 2, can have scientifically and economically important uses. This chart captures the number of yearly scientific publications that refer to them.

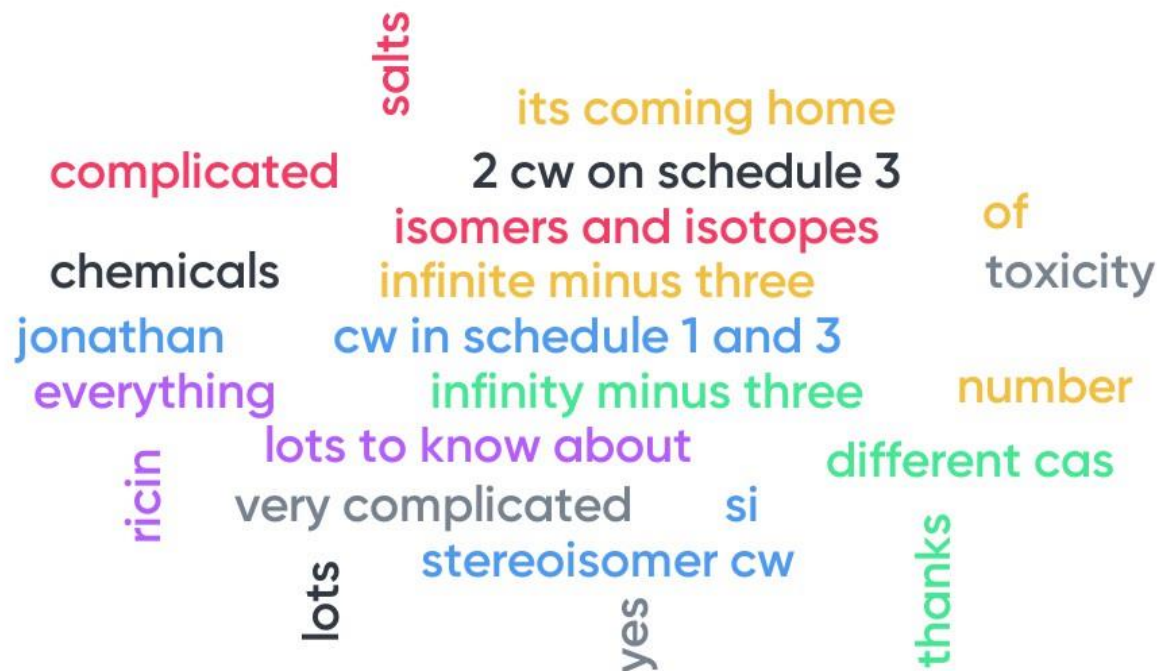


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Answers from Audience

What did you learn today?

Mentimeter



16

Scientific Advisory Board from January to June 2018



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Organisation for the Prohibition of Chemical Weapons

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

Report of the Scientific Advisory Board at its Twenty-Seventh Session
(SAB-27/1, dated 23 March 2018)

Director-General's Response to the Report of the Twenty-Seventh Session of the Scientific Advisory Board
(EC-88/DC.5, dated 9 May 2018)

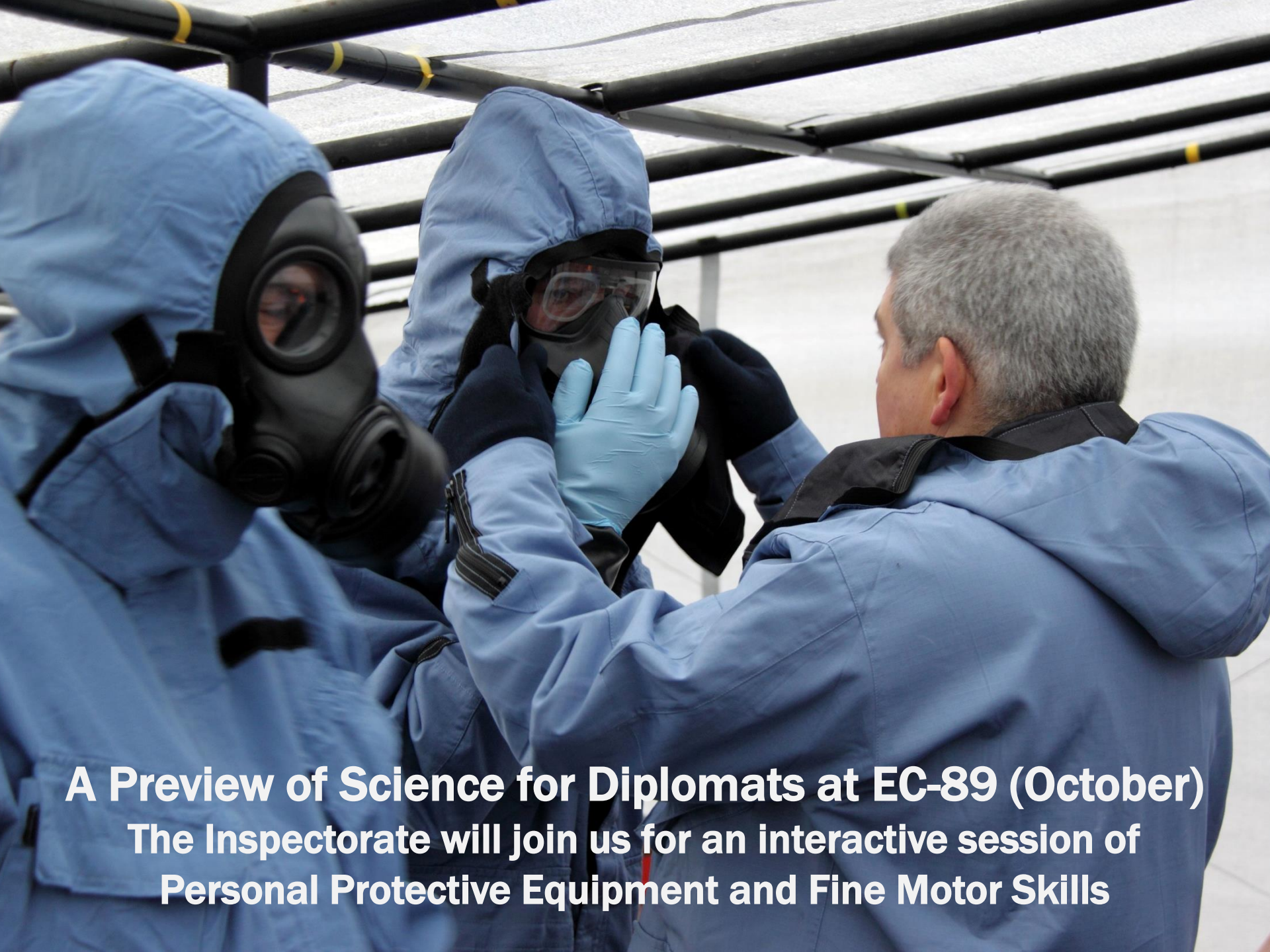
Report of the Scientific Advisory Board on Developments in Science and Technology for the Fourth Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention
(RC-4/DC.1, dated 30 April 2018)

Response by the Director-General to the report of the Scientific Advisory Board on Developments in Science and Technology for the Fourth Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention
(RC-4/DC.2, dated 1 June 2018)

The banner features the OPCW logo at the top left. Below it, five horizontal cards with colored backgrounds (blue, green, orange, red, and purple) provide summaries of key reports and meetings. Each card includes a circular icon representing the topic (e.g., a magnifying glass, a person in a hazmat suit, a man in a suit, a globe with chemical symbols, and two men talking) and a QR code on the right side for more information.



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A Preview of Science for Diplomats at EC-89 (October)
The Inspectorate will join us for an interactive session of
Personal Protective Equipment and Fine Motor Skills



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منظمة حظر الأسلحة الكيميائية

禁止化学武器组织

Organisation for the Prohibition of Chemical Weapons

Organisation pour l'Interdiction des Armes Chimiques

Организация по запрещению химического оружия

Organización para la Prohibición de las Armas Químicas