OPCW

Organisation for the Prohibition of Chemical Weapons

Suitability for Fieldwork: The Science and Technology of Physical Protection

Science for Diplomats at EC-89
The Hague, 9 October 2018

Jonathan E. Forman, Ph.D.; Science Policy Adviser and SAB Secretary
Cheng Tang; 2019 SAB Chair Elect
The Inspectorate Safety and Chemistry Cell
The OPCW Equipment Store

Bringing Science Advice to the Review Conference

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

Advice on Advances in Science and Technology

(RC-4/DG.1, paragraphs 16-23)

- Given the potential impact on the Convention of the convergence of chemistry and biology, the SAB and Secretariat should keep under review developments in biological and biomediated processes, metabolic engineering, the synthesis of replicating organisms, the use of enzymes for decontamination, and biotechnology, as well as any other related aspects it deems relevant to the Convention, and report on their implications for the Convention.
- The SAB and the Secretariat should continue to work across areas of overlap between the Chemical Weapons Convention and the Biological Weapons Convention and promote joint discussions amongst international experts in these areas.
- The SAB and Secretariat should continue to assess developments in technical fields of increasing relevance to the Convention, such as computational chemistry, Big Data, informatics and artificial intelligence, forensic science, remote sensing, and unmanned automated systems.
- Although biological or biomediated processes do not currently appear likely to be suitable for production of traditional chemical warfare agents, the Secretariat should continue to monitor developments closely.
- The SAB continues to emphasise the recommendation that, taking into consideration the convergence of chemistry and biology as it relates to the synthesis of chemicals, any process designed for the formation of a chemical substance should be covered by the term "produced by synthesis".
- As the number and variety of facilities using a biological or biomediated process to produce chemicals increase, the degree of relevance of these facilities to the object and purpose of the Convention will need to be assessed to determine whether there are grounds to exempt certain types of facilities or a need to review thresholds for declaration and inspection of other chemical production facilities (OCPFs).
- In view of the many interesting and potentially enabling technologies that are described in this report, the Secretariat is encouraged to consider ways in which such technologies may prove valuable in enhancing its capability to verify compliance with the Convention and to assist States Parties in improving their own capabilities. This should be informed by capability requirements, not the technology itself. In general, the SAB is of the view that technological change is best considered from a practical perspective, focusing on capabilities relevant to the Convention, irrespective of scientific discipline.
- The SAB recommends that the Secretariat adopt a systematic approach to the continued professional development of its technical experts to ensure that they possess the knowledge and expertise to identify, evaluate, and apply scientific and technological advances relevant to its work.

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

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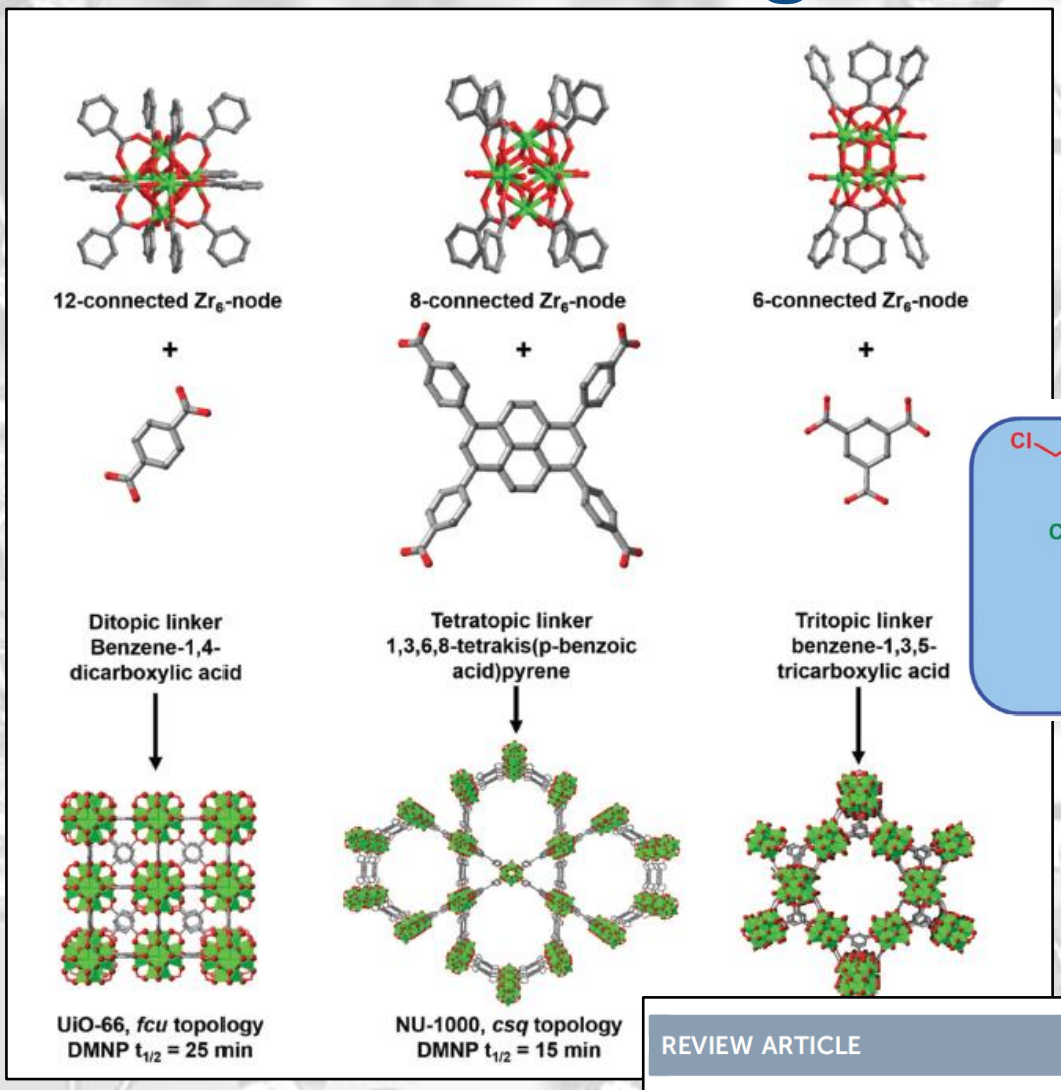
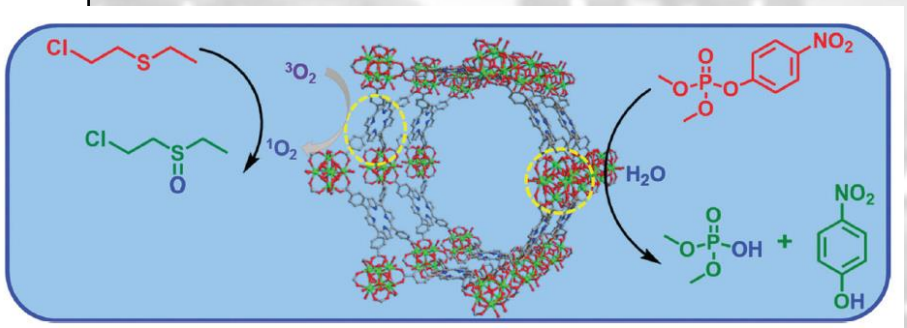
Metal Organic Frameworks





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Metal–organic frameworks for the removal of toxic industrial chemicals and chemical warfare agents

N. Scott Bobbitt,[a] Matthew L. Mendonca,[a] Ashlee J. Howarth,[b] Timur Islamoglu,[b] Joseph T. Hupp,[b] Omar K. Farha*[bc] and Randall Q. Snurr*[a]

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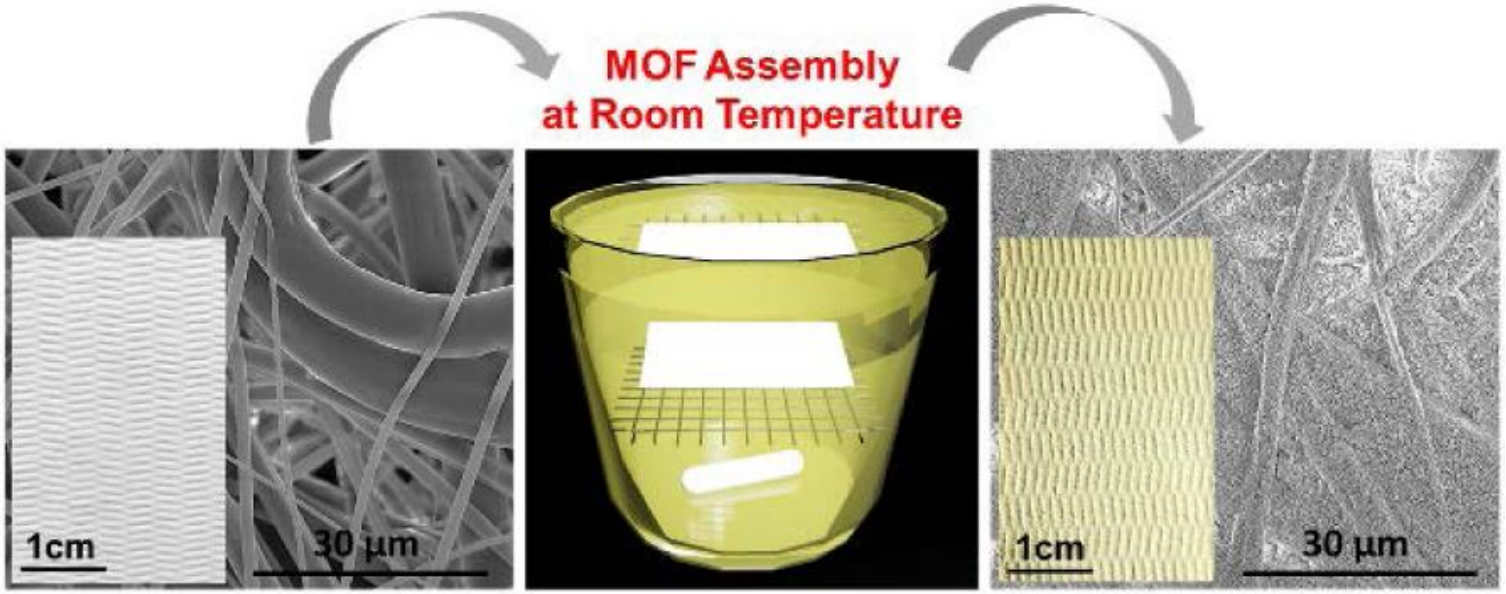
Metal Organic Frameworks

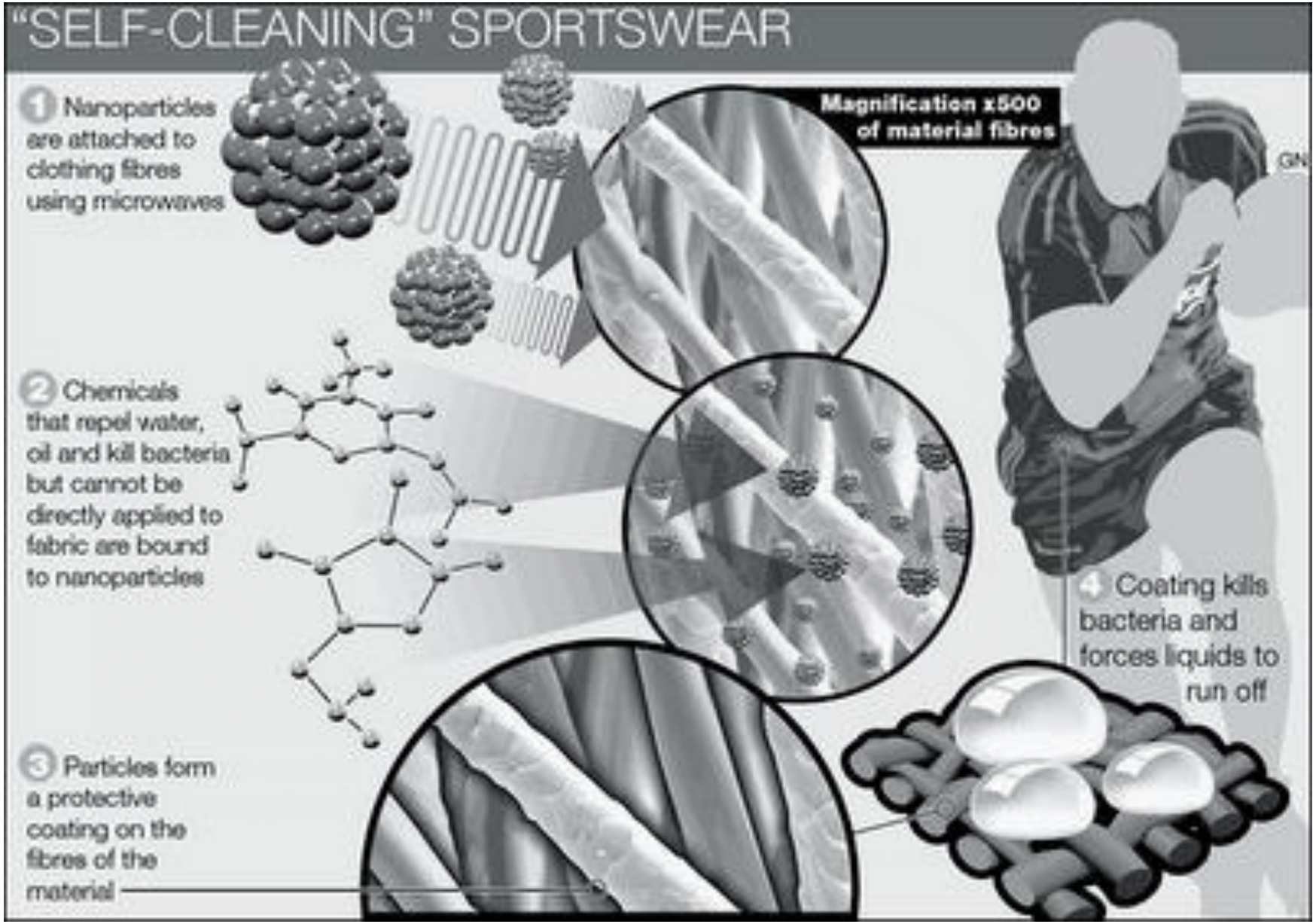
DOI: 10.1002/anie.201508407

Metal Organic Frameworks

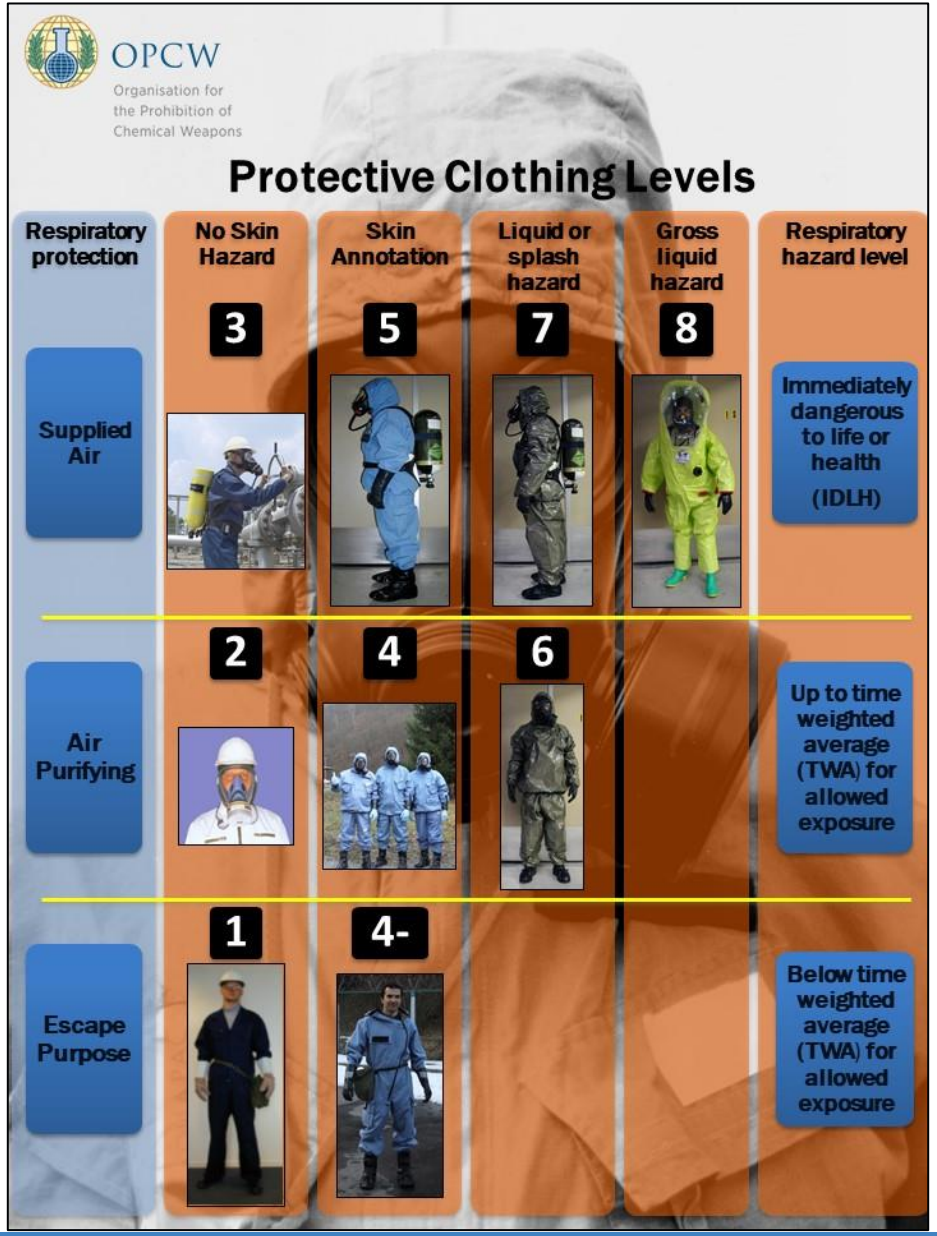
https://cen.acs.org/articles/92/i49/Building-Better-Gas-Mask.htm |



DOI: 10.1021/acs.chemmater.7b00949


"SELF-CLEANING" SPORTSWEAR
1 Nanoparticles are attached to clothing fibres using microwaves
Magnification x500 of material fibres
2 Chemicals that repel water, oil and kill bacteria but cannot be directly applied to fabric are bound to nanoparticles
3 Particles form a protective coating on the fibres of the material
4 Coating kills bacteria and forces liquids to run off


Smart Glass
Miniature Sensor
Chemical Absorbing Material for Passive Sampler
Electrochemical Sensing Device
Colorimetric Toxic Gas Sensing Array
Textile Integrated Gas Sensor
Smart Contact Lens
Smart Clothing
Chest Strap (Heart Rate Monitor)
E-skin
Activity Monitor Wristband/Watch
Implantable Sensor



"The SAB has reviewed available personal protection equipment (PPE). While many reports of nanotechnologies and other means of potentially enhancing PPE exist…, there have been no significant advances in PPE since the Third Review Conference."

Why?

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Organisation for the Prohibition of Chemical Weapons

Suitability for Fieldwork: The Science & Technology of Physical Protection

Safety & Analytical Chemistry Cell (SACC)
Technical Secretariat

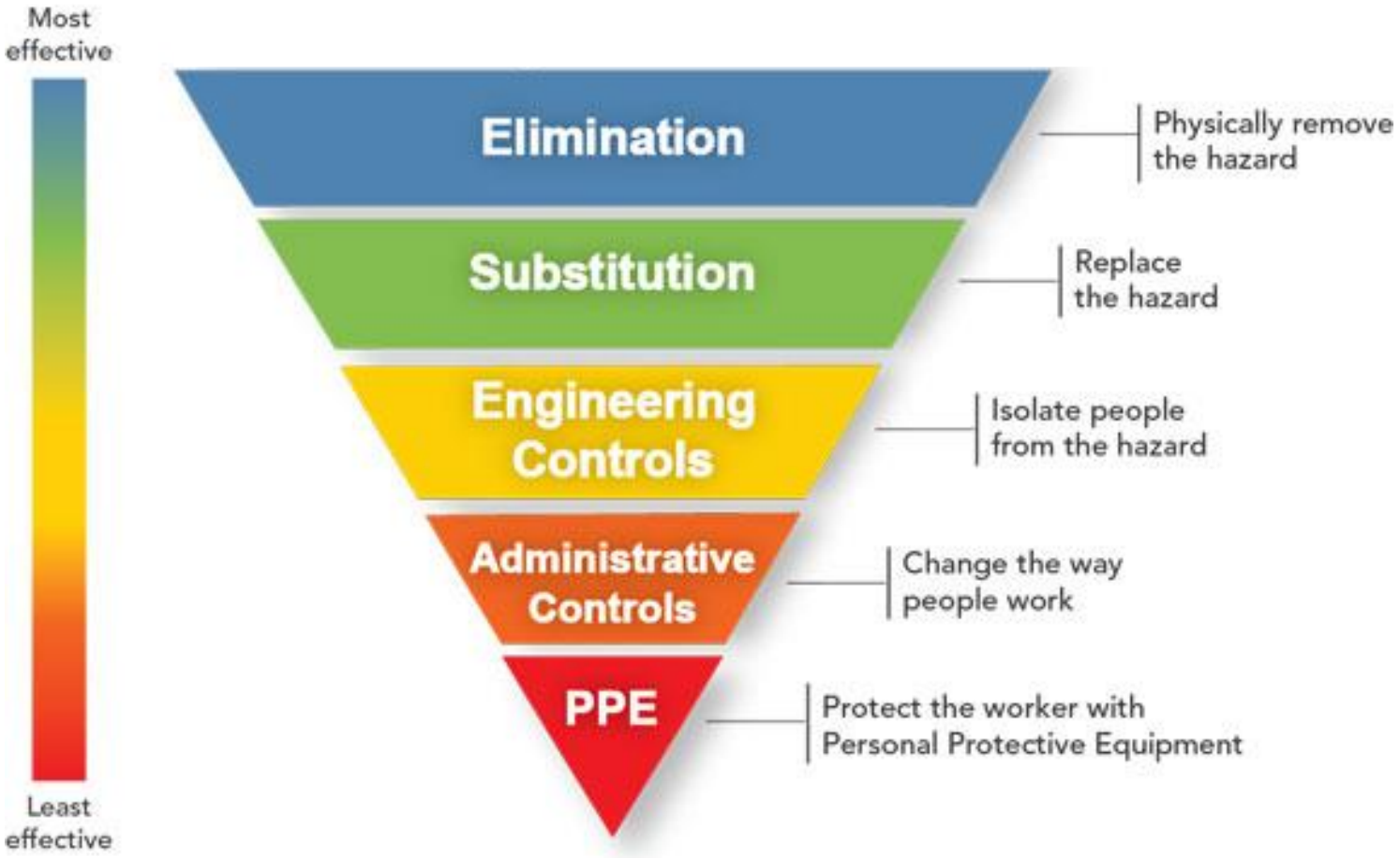
Science for Diplomats at EC-89

A HAZARD is something that has the potential to harm you

RISK is the likelihood of a hazard causing harm

Control and Mitigation

Hierarchy of Controls



Controls: Examples

Hazard	Risk	Mitigation
Water (Swimming pool)	Drowning, choking	Remove body of water (Elimination), replace with sand pit (Substitution), fence around (Engineering), procedural conduct (Administrative), life jackets (PPE)
Wet floor	…	…
Electricity	…	…
Sunlight	…	…

Controls: OPCW Inspectors

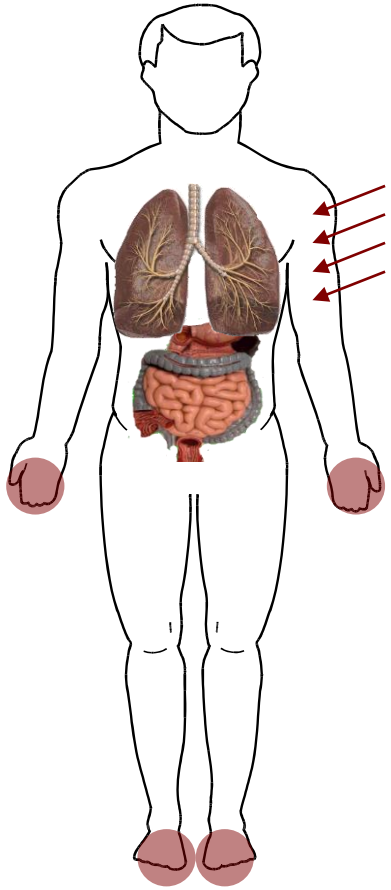
- OPCW Inspectors have no other option but to face the hazards in the field.
- Toxic Chemical Hazards
- Other hazards as well.
- Compromise between protection and dexterity
- **Inspectors must usually rely on the *last line of defence* – Personal Protective Equipment**

What is Personal Protective Equipment (PPE)?

- Articles worn or equipment used in order to provide shield between the wearer and harmful contaminants in the environment
- Appropriate training needed to use PPE

OPCW Protective Clothing Levels

Protection systems against Exposure to Toxic Chemicals including Chemical Warfare Agents



Routes of exposure

1. Direct Contact

2. Inhalation

3. Vapour Absorption

4. Ingestion

OPCW Protective Clothing Levels

PCL 1

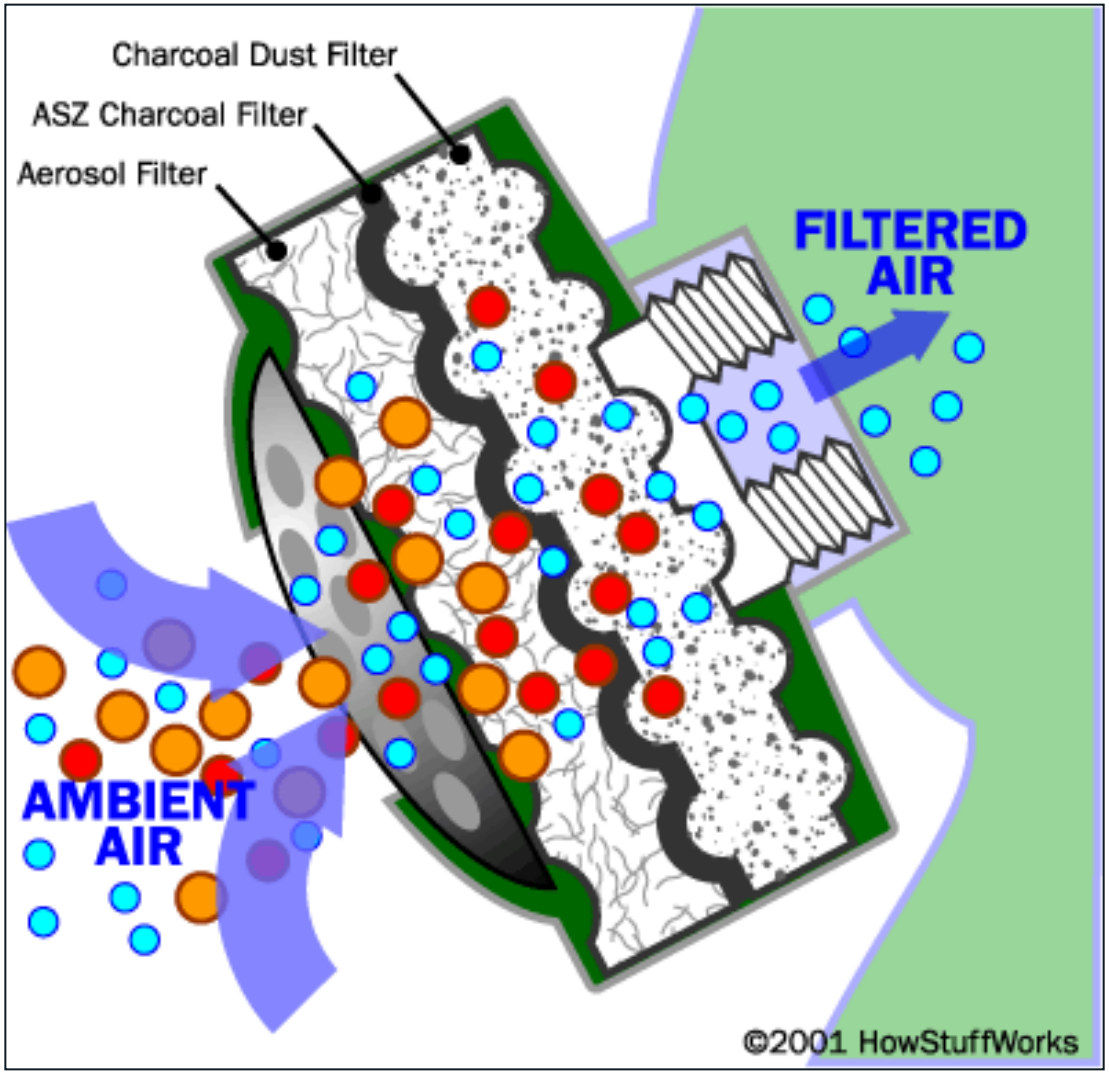
No Skin Hazard

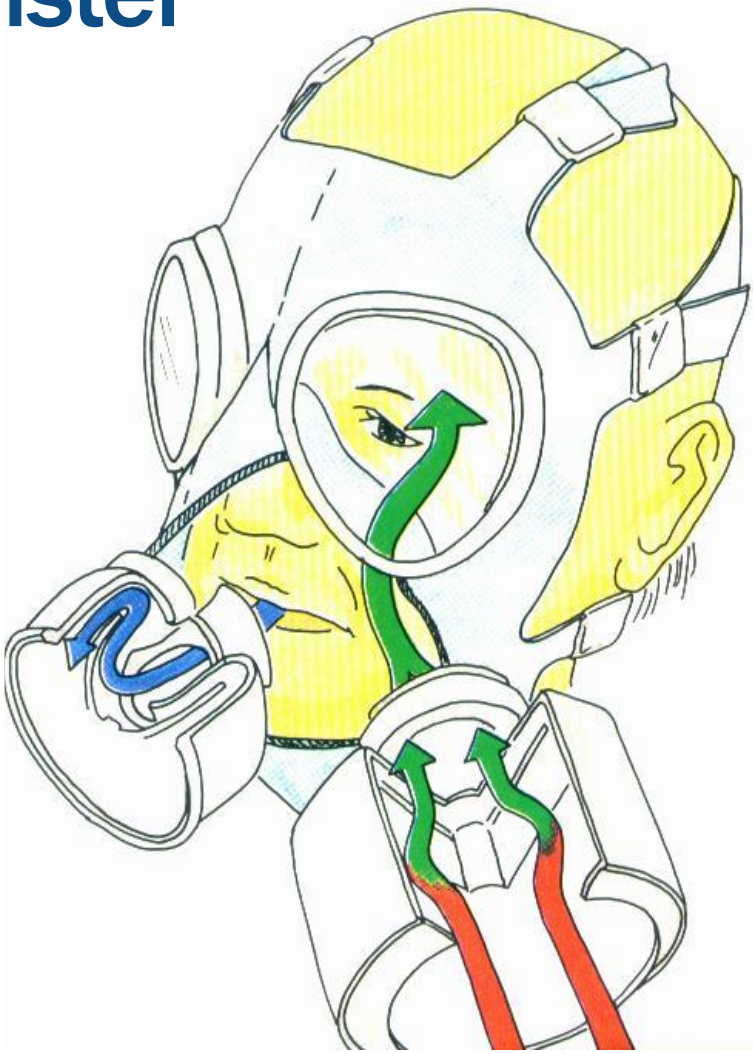
OPCW Protective Clothing Levels

PCL 2

No Skin Hazard - Respiratory Hazard

The Filter Canister





OPCW Protective Clothing Levels

PCL 3

No Skin Hazard -
Respiratory Hazard

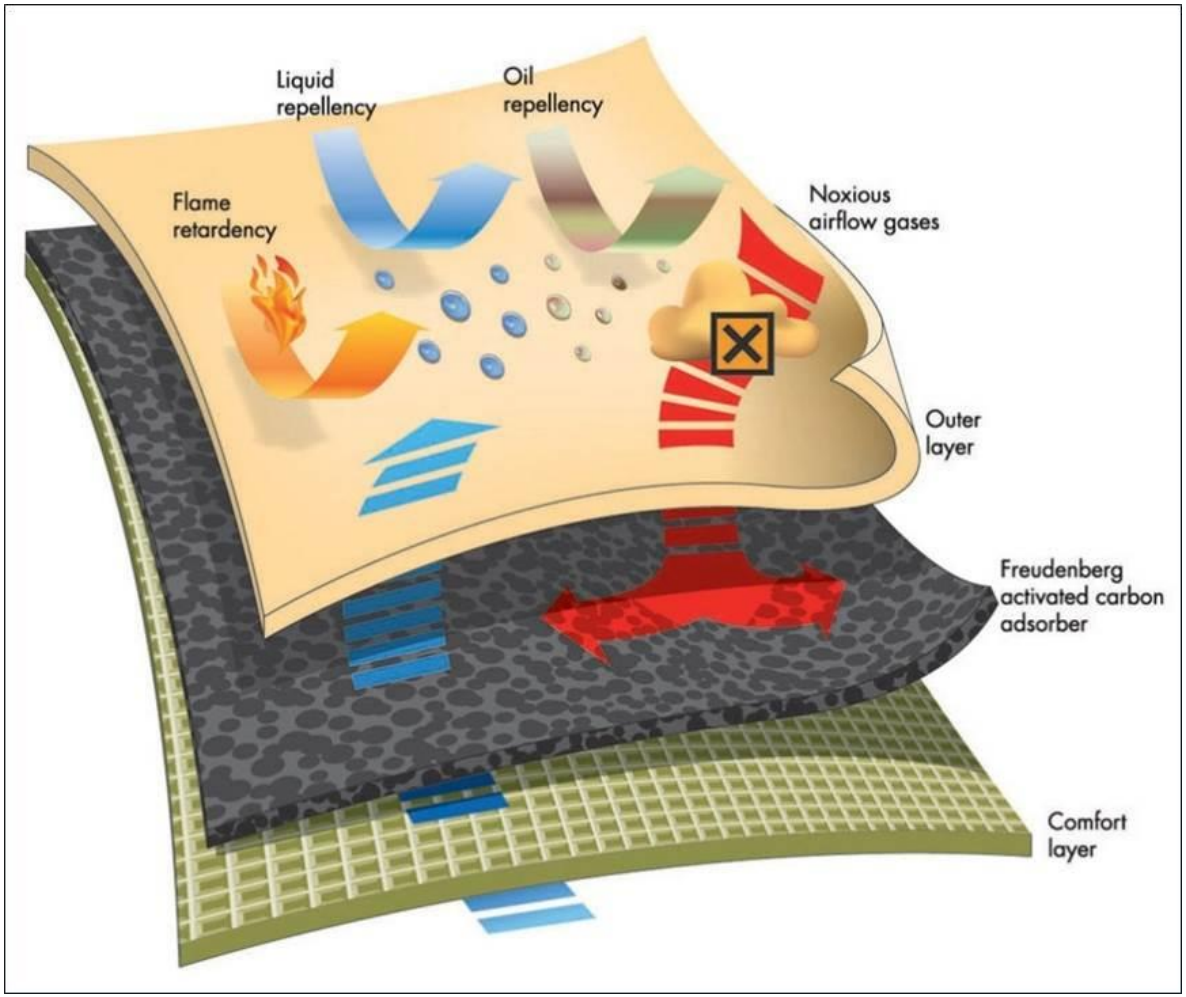
OPCW Protective Clothing Levels

PCL 4

Skin Hazard - Respiratory hazard

PCL 4 -

Air permeable fabric



Science for Diplomats at EC-89

OPCW Protective Clothing Levels

PCL 5

Skin Hazard -
Respiratory Hazard

PCL 6

PCL 7

Liquid/Splash Hazard - Respiratory Hazard

Increasing hazard

OPCW Protective Clothing Levels

PCL 8

- Fully encapsulated gas tight chemical protective suit, worn with chemical protective boots and a supplied air system (SCBA or air-line).
- Extensive training required

Liquid/Splash hazard - Respiratory Hazard

OPCW Protective Clothing Levels

BODY ARMOUR

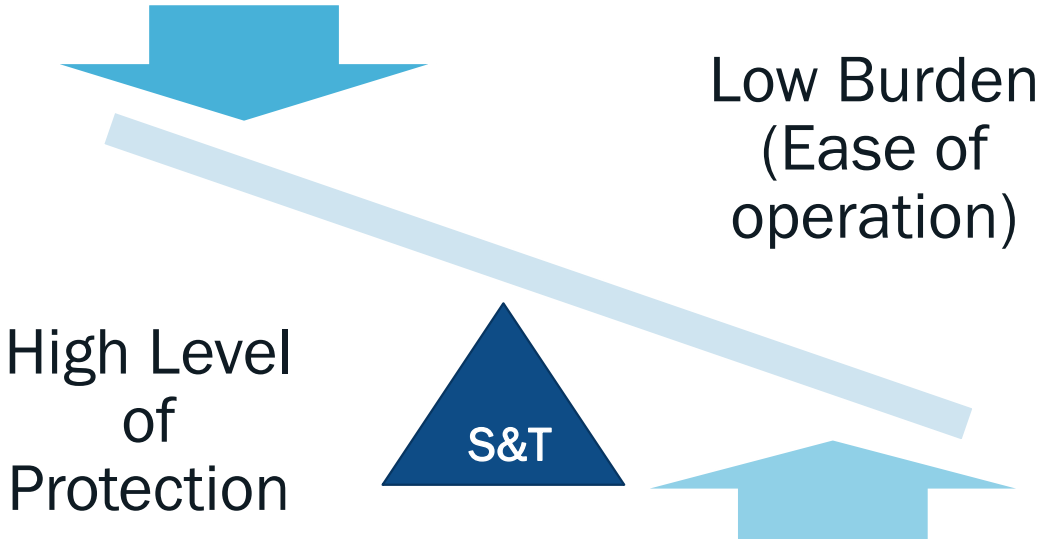
- Firearm-fired projectiles, small fragments from explosives
- Normally worn with PCL4 in the field

Gloves

From the Perspective of an Inspector...

A Balancing Act

Can science and technology help redress the balance?



Knowledge Check

Which level of PPE would provide the most protection from chemical hazards?

a. PLC 2
b. PLC 4
c. PCL 8
d. PCL 4 with body armour

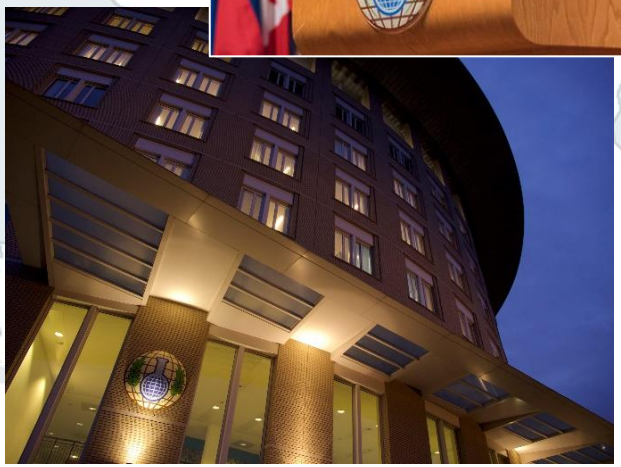
C

PCL 8

Fully encapsulated gas tight chemical protective suit, worn with chemical protective boots and a supplied air system (SCBA or air-line)

Who are the Science Advice Beneficiaries?

Independent Scientific Advisory Board (25 members from 25 States Parties)



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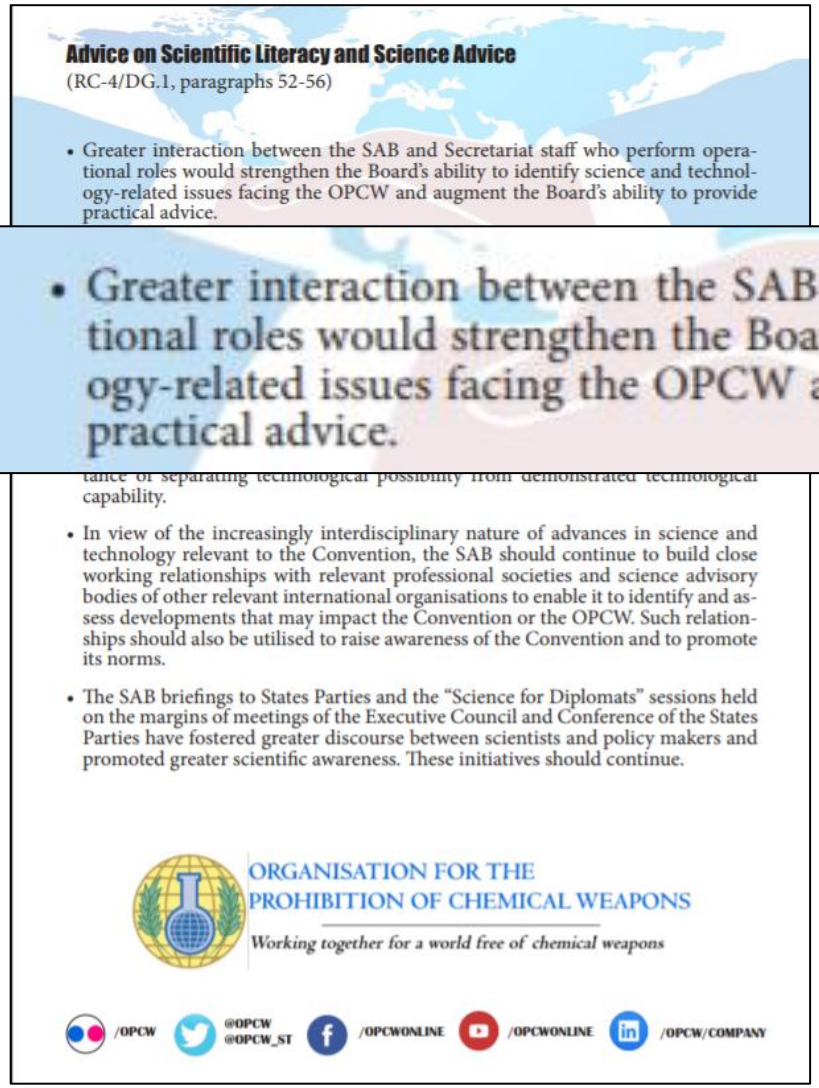

Advice on Scientific Literacy and Science Advice
(RC-4/DG.1, paragraphs 52-56)

- Greater interaction between the SAB and Secretariat staff who perform operational roles would strengthen the Board's ability to identify science and technology-related issues facing the OPCW and augment the Board's ability to provide practical advice.

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tance of separating technological possibility from demonstrated technological capability.

- In view of the increasingly interdisciplinary nature of advances in science and technology relevant to the Convention, the SAB should continue to build close working relationships with relevant professional societies and science advisory bodies of other relevant international organisations to enable it to identify and assess developments that may impact the Convention or the OPCW. Such relationships should also be utilised to raise awareness of the Convention and to promote its norms.
- The SAB briefings to States Parties and the "Science for Diplomats" sessions held on the margins of meetings of the Executive Council and Conference of the States Parties have fostered greater discourse between scientists and policy makers and promoted greater scientific awareness. These initiatives should continue.

ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS
Working together for a world free of chemical weapons

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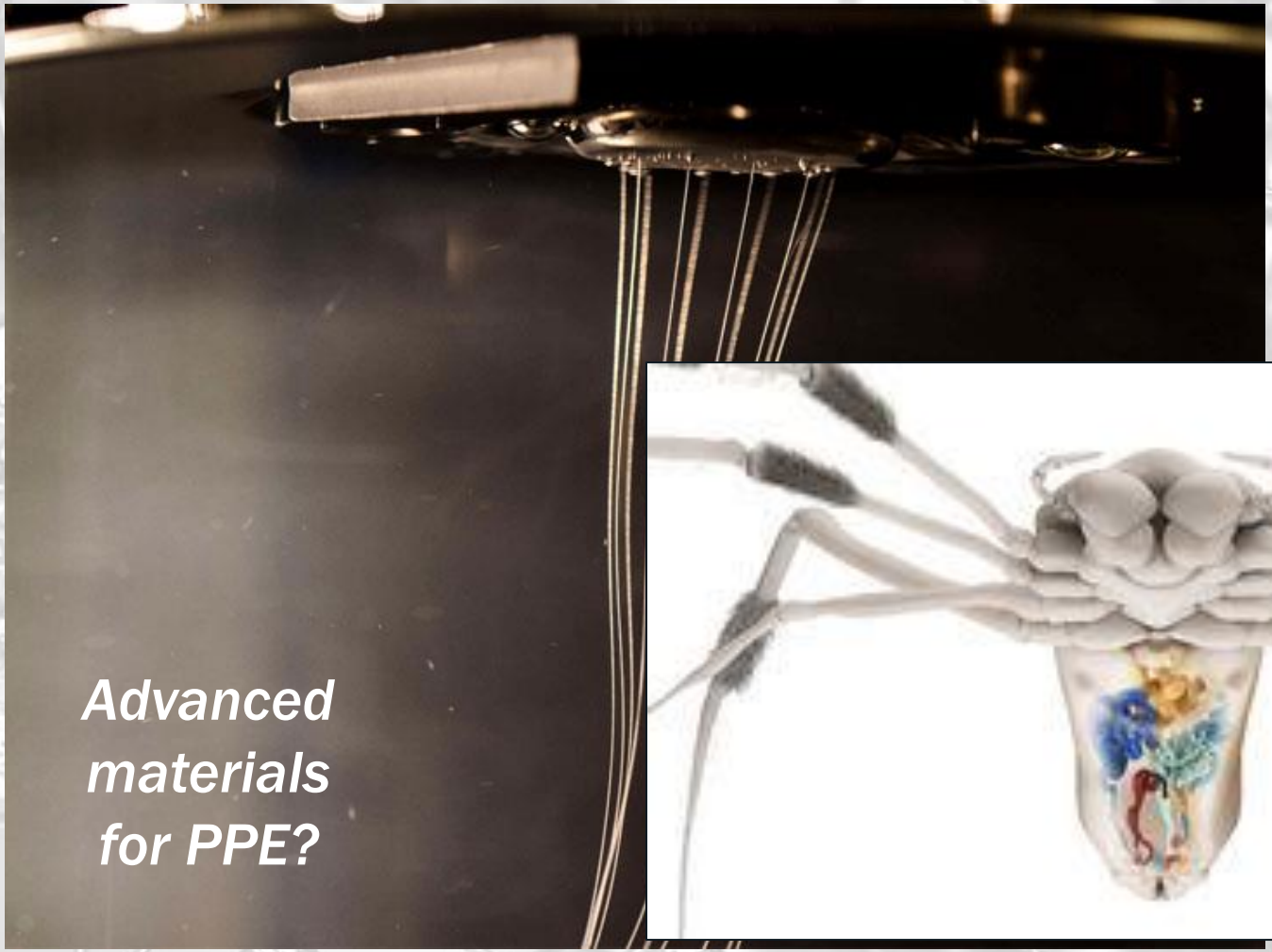
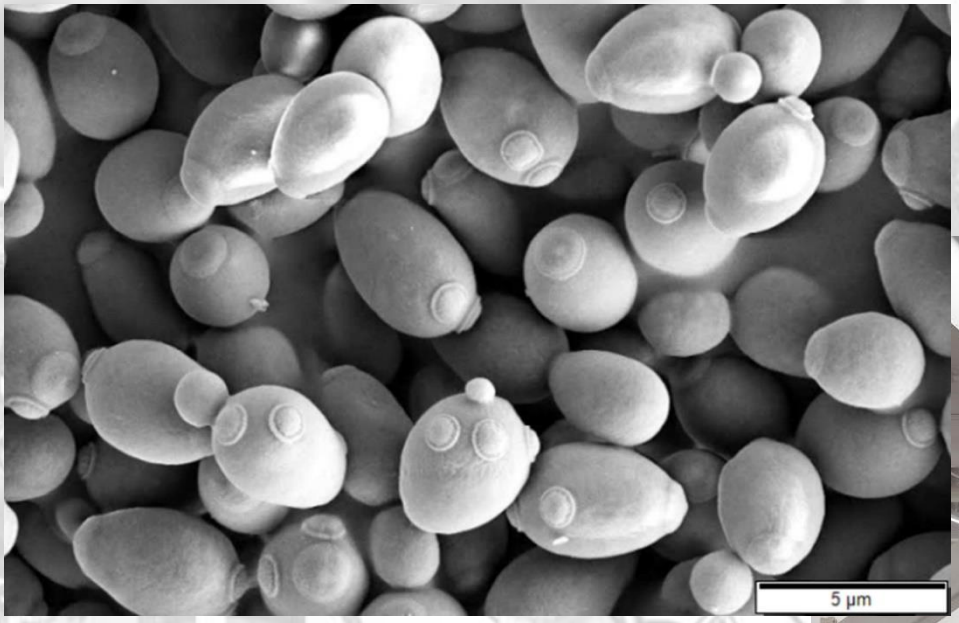
Understand both the Needs and the Possibilities



Advanced materials for PPE?

http://www.sciencemag.org/news/2017/10/spinning-spider-silk-startup-gold

Understand both the Needs and the Possibilities



Many Examples of Interesting Science: Is any of it Fieldable?

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350. The Secretariat might consider how it can engage in relevant innovation ecosystems. This might be enabled through research programmes involving the OPCW and DLs and through projects funded under Article XI programmes. The Secretariat might explore opportunities for engagement with scientific developers through the Article XI research support programme.

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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