# Science for Diplomats at EC-89

## Suitability for Fieldwork: The Science and Technology of Physical Protection

Are you as agile as an OPCW Inspector?
Join us to find out!

**Tuesday 9 October**
**13:30 – 14:45**
**Ooms Room**
***Light lunch available at 13:00***

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 Recomme
# to the Fourth Review Conference
# the Chemical Weapons Convent


## Advice on Advances in Science and Technology

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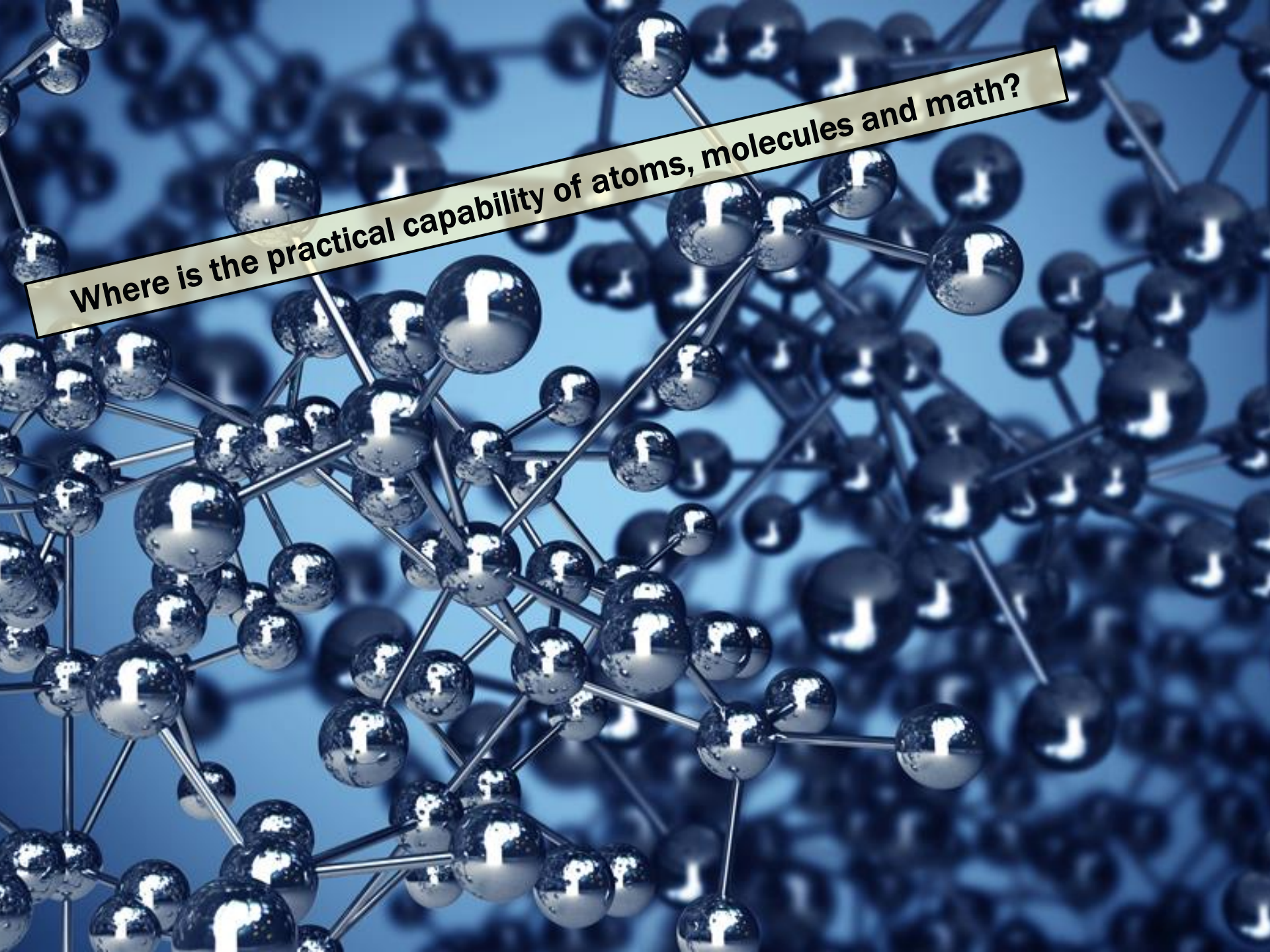
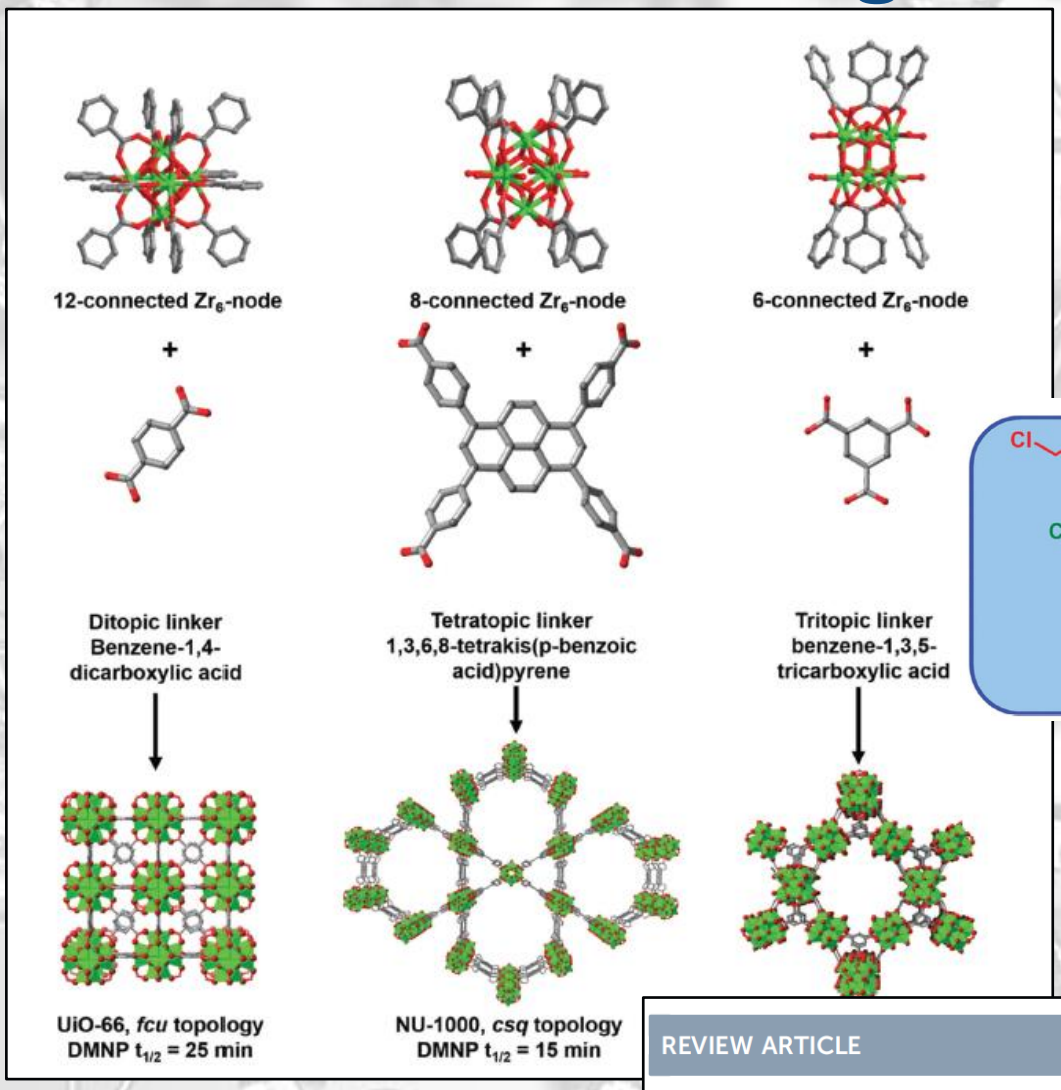
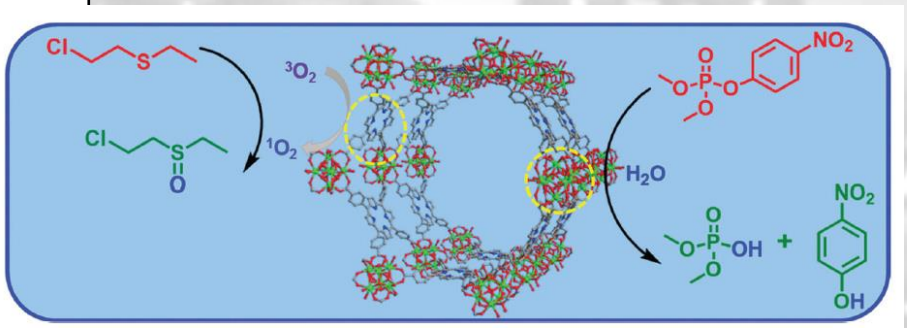

Where is the practical capability of atoms, molecules and math?

# For a Metal Organic Framework?

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Cite this: *Chem. Soc. Rev.*, 2017, 46, 3357

## 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]

OPCW

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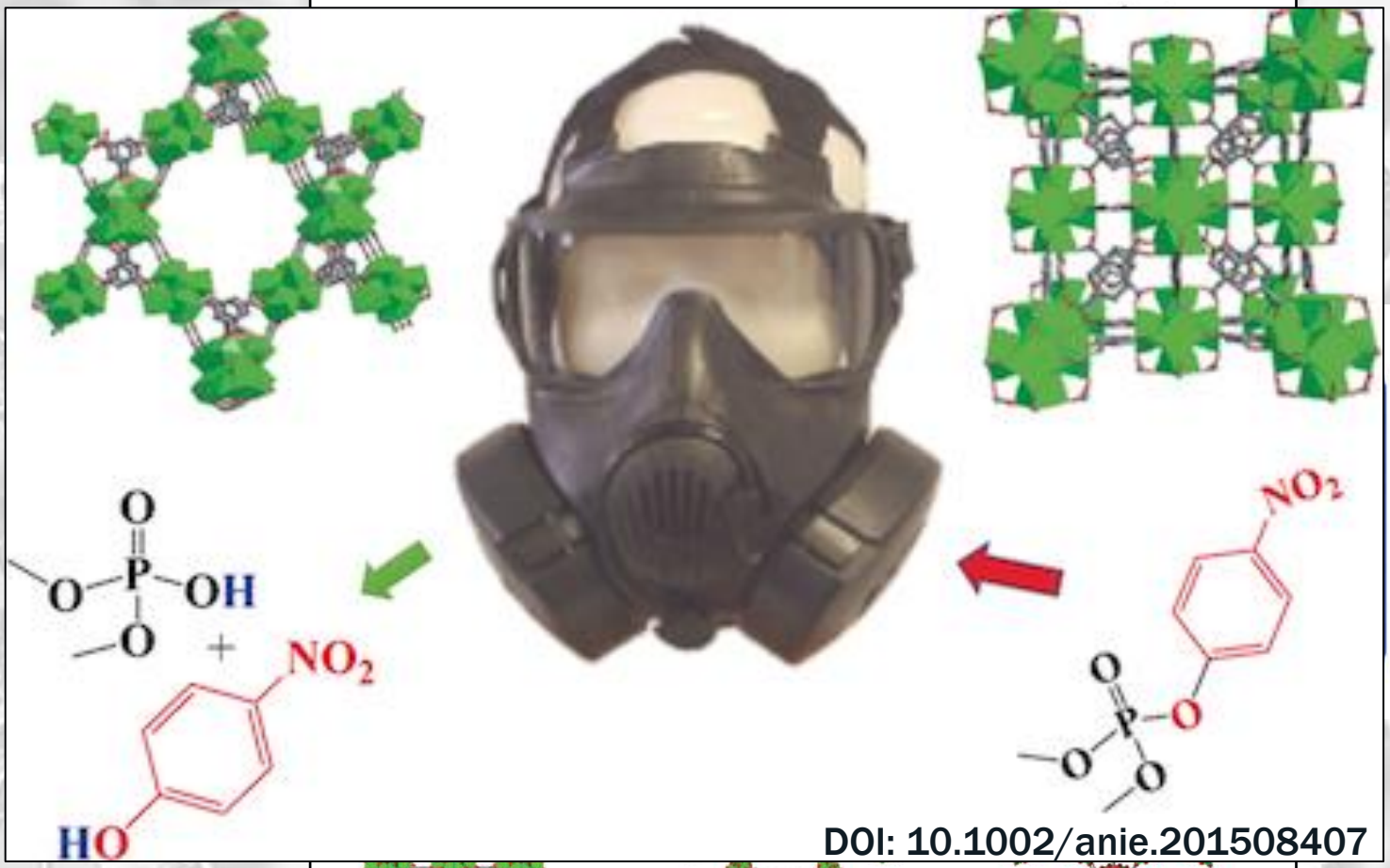


DOI: 10.1002/anie.201508407

UiO-66, *fcu* topology
DMNP $t_{1/2}$ = 25 min

NU-1000, *csq* topology
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https://cen.acs.org/articles/92/i49/Building-Better-Gas-Mask.htm |

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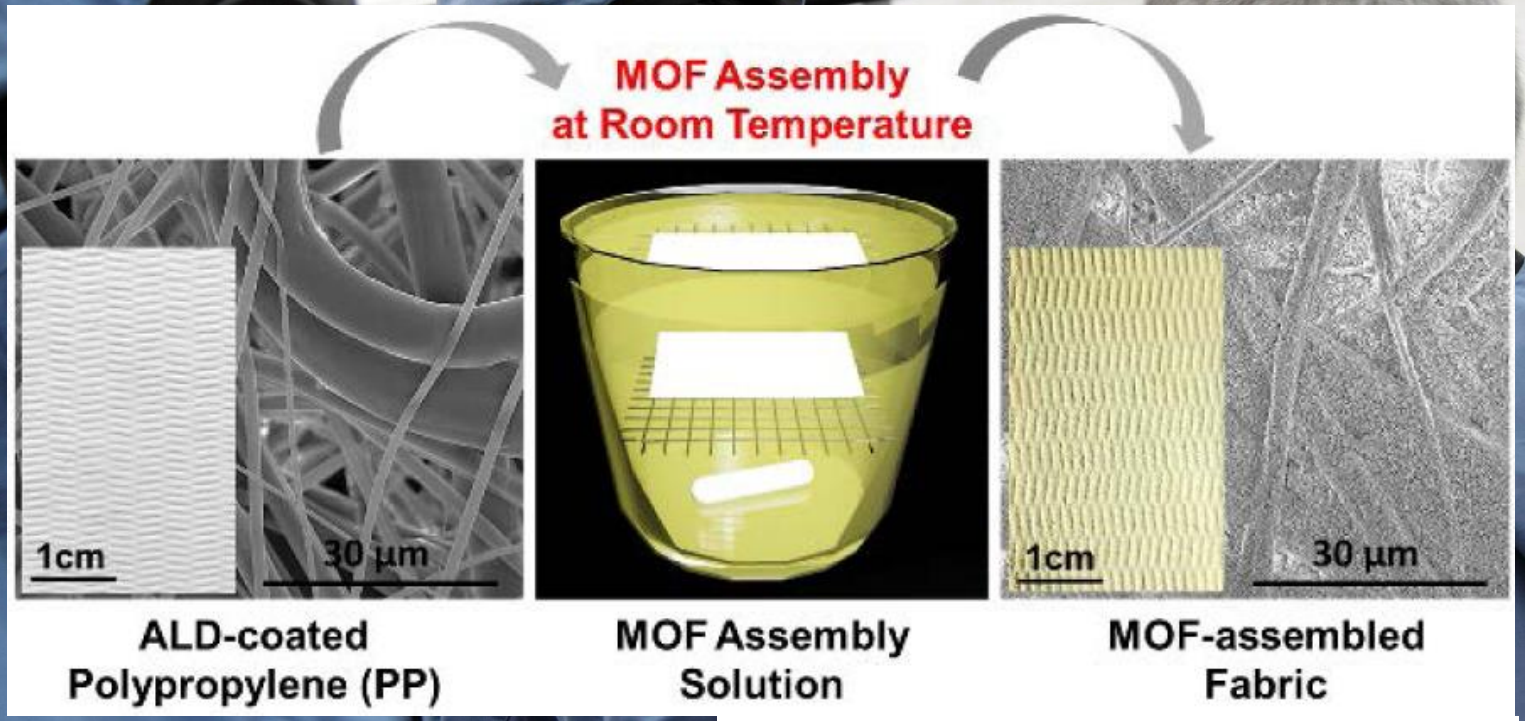
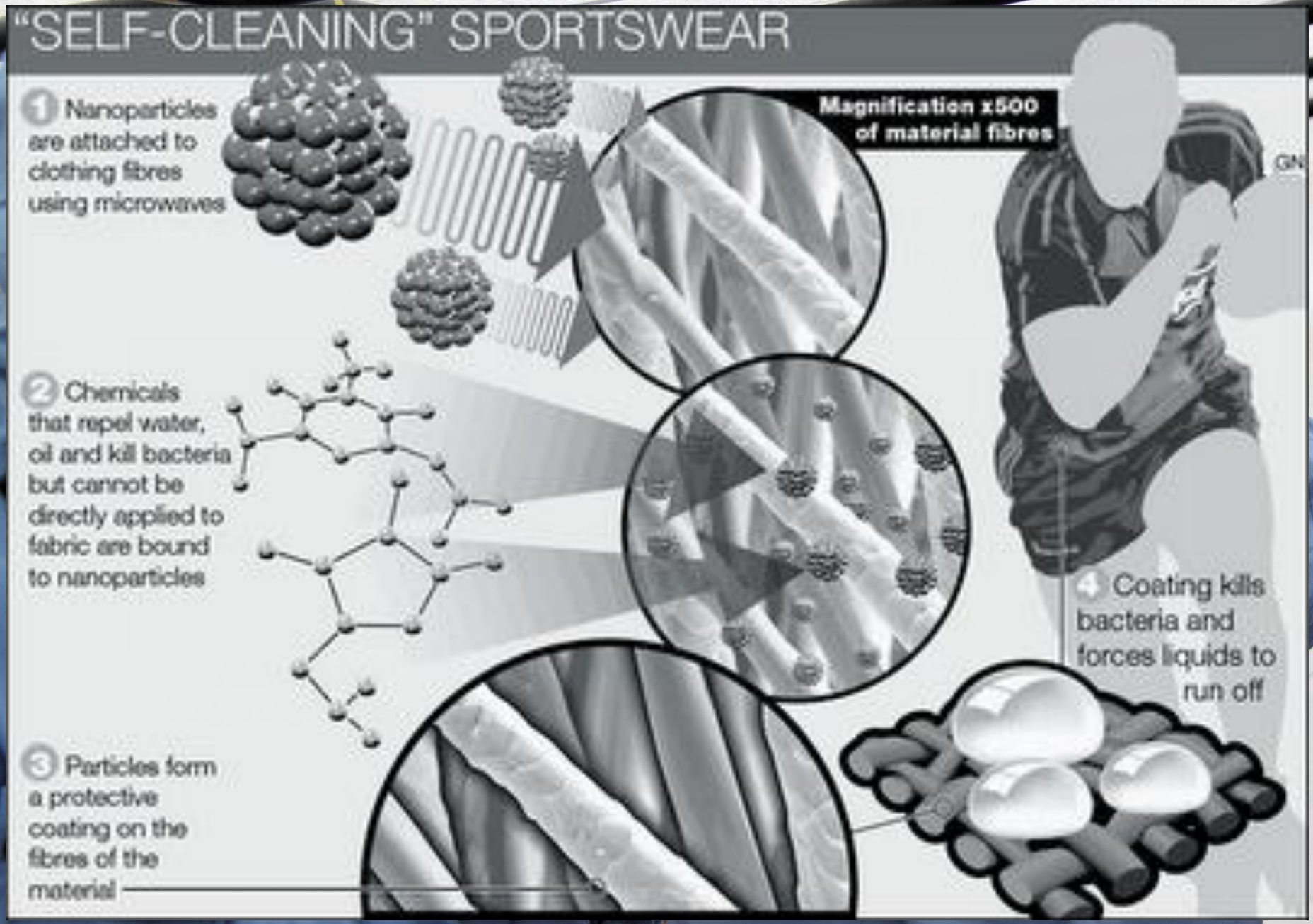



DOI: 10.1021/acs.chemmater.7b00949

# "SELF-CLEANING" SPORTSWEAR




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

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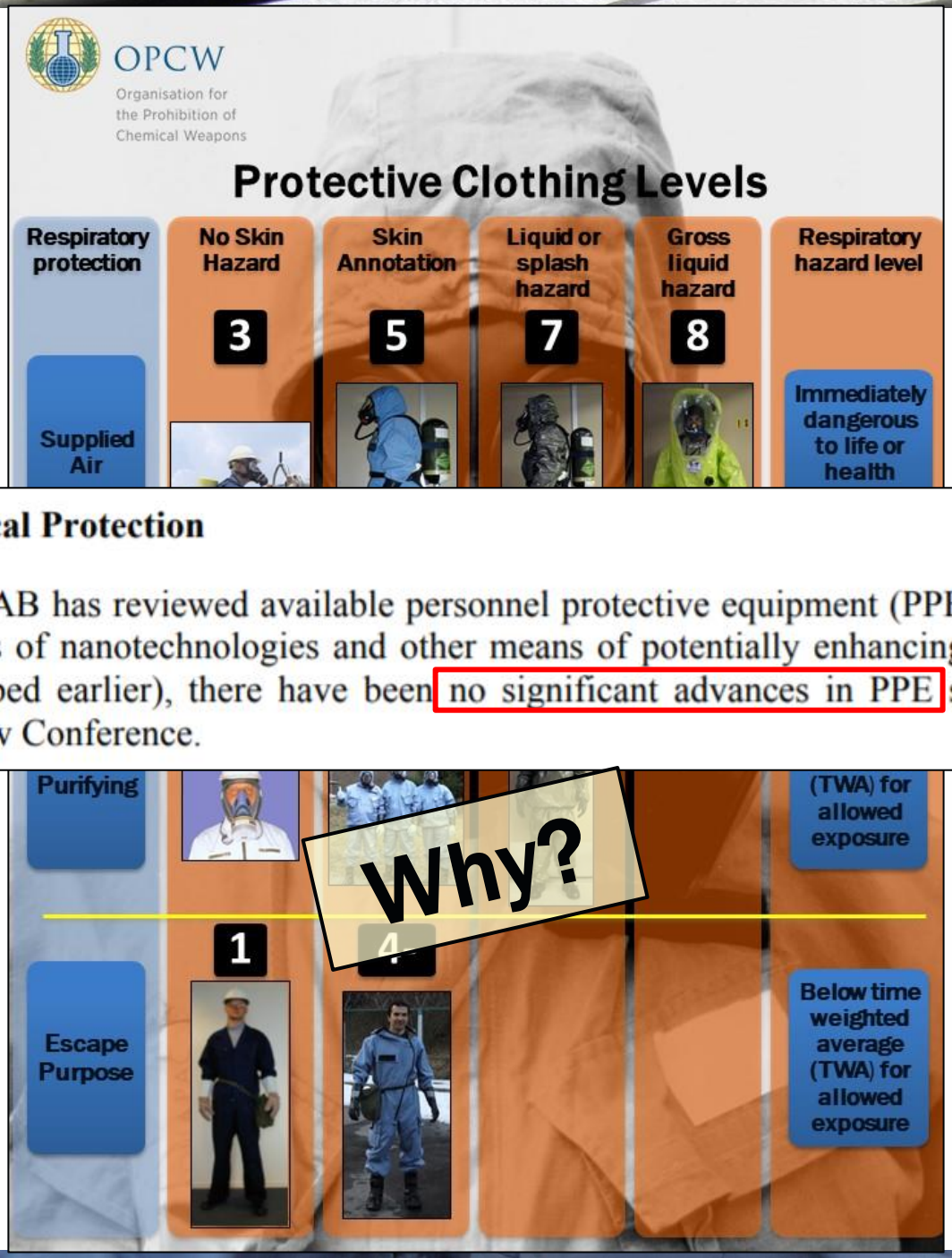
# Protective Clothing Levels

| Respiratory protection | No Skin Hazard | Skin Annotation | Liquid or splash hazard | Gross liquid hazard | Respiratory hazard level |
|---|---|---|---|---|---|
| Supplied Air | 3  | 5  | 7  | 8  | Immediately dangerous to life or health (IDLH) |
| Air Purifying | 2  | 4  | 6  | | Up to time weighted average (TWA) for allowed exposure |
| Escape Purpose | 1  | 4-  | | | Below time weighted average (TWA) for allowed exposure |




**Physical Protection**

294. The SAB has reviewed available personnel protective equipment (PPE). While many reports of nanotechnologies and other means of potentially enhancing PPE exist (as described earlier), there have been no significant advances in PPE since the Third Review Conference.

# And Now… Your Chance to Hear Directly from the Inspectors

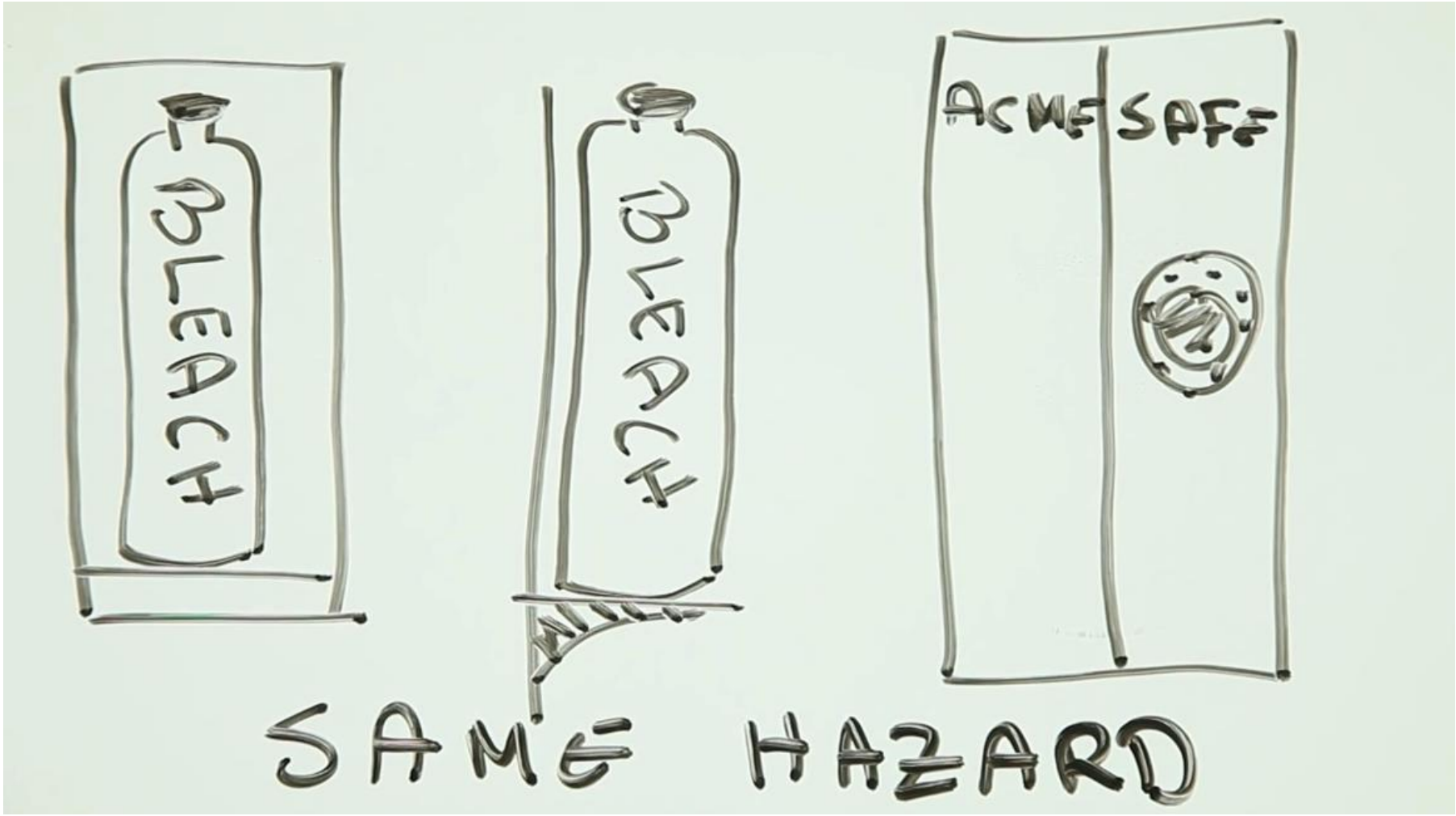
OPCW

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**

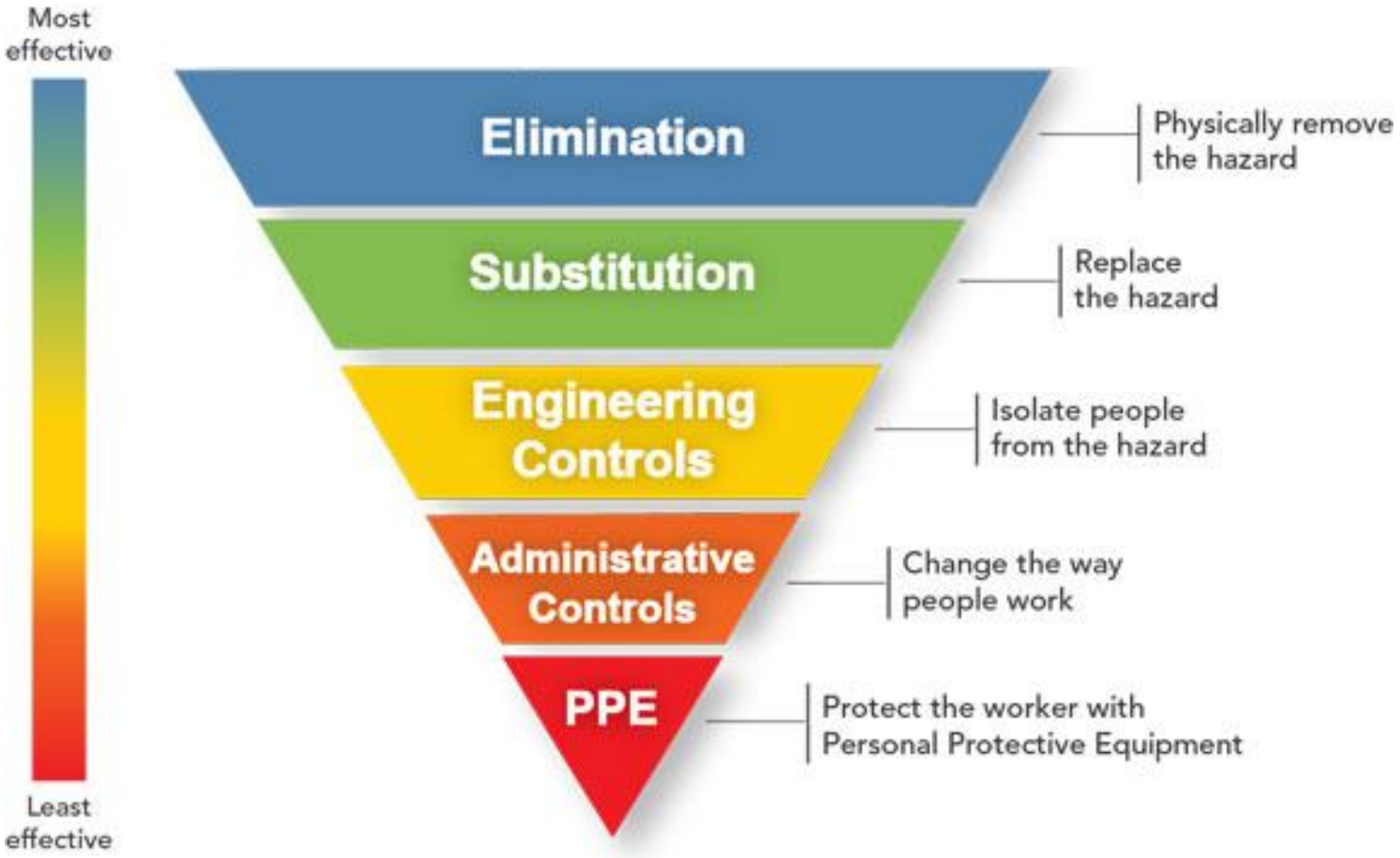

BLEACH
BLEACH
ACME SAFE
SAME HAZARD

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

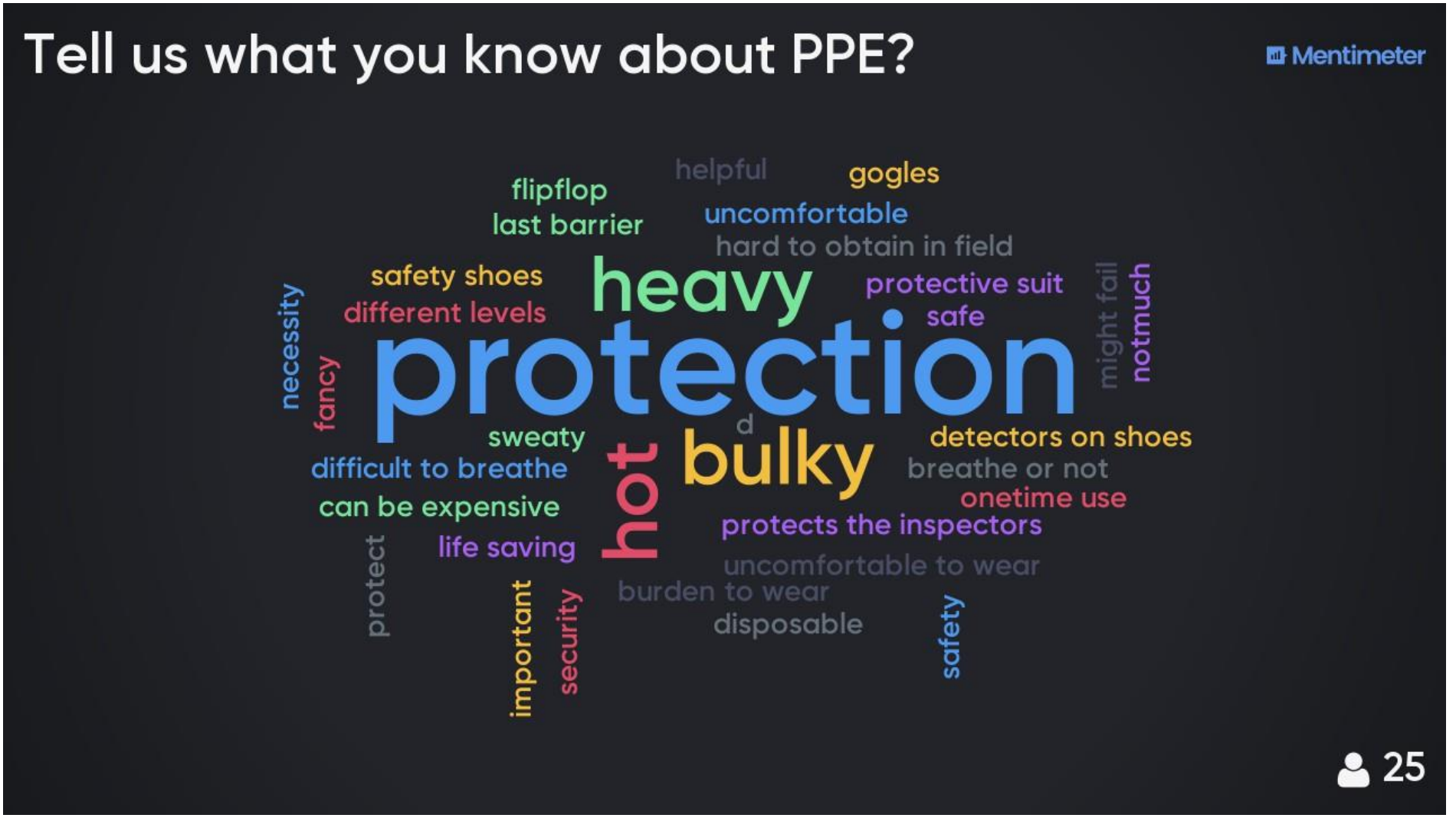
| Hazard | Risk | Mitigation |
|---|---|---|
| Water (Swimming pool) | Drowning, choking | Remove body of water (Elimination), replace with sand pit (Substitution), fence around (Engineering), procedural conduct (Administrative), life jackets (PPE) |
| Wet floor | … | … |
| Electricity | … | … |
| Sunlight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

# 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 do you know about PPE?

# Answers from Participants




NOTICE
ALL SAFETY EQUIPMENT
Must Be Worn Past This Point

# What is Personal Protective Equipment (PPE)?

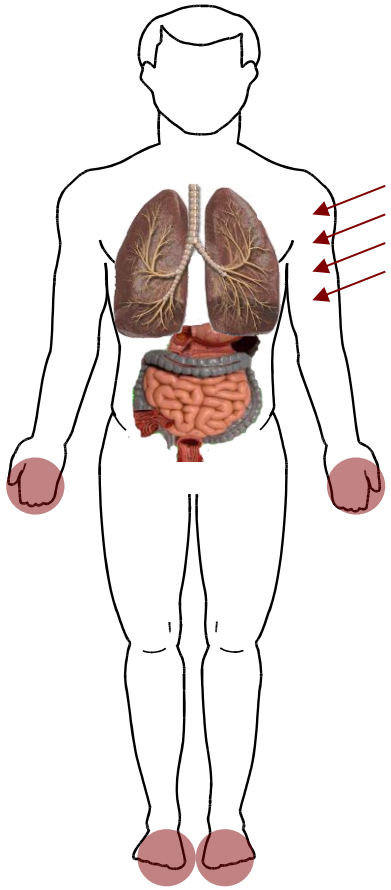
- Articles worn or equipment used in order to provide shield between the wearer and harmful contaminants in the environment
- Appropriate training needed to use PPE





# 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

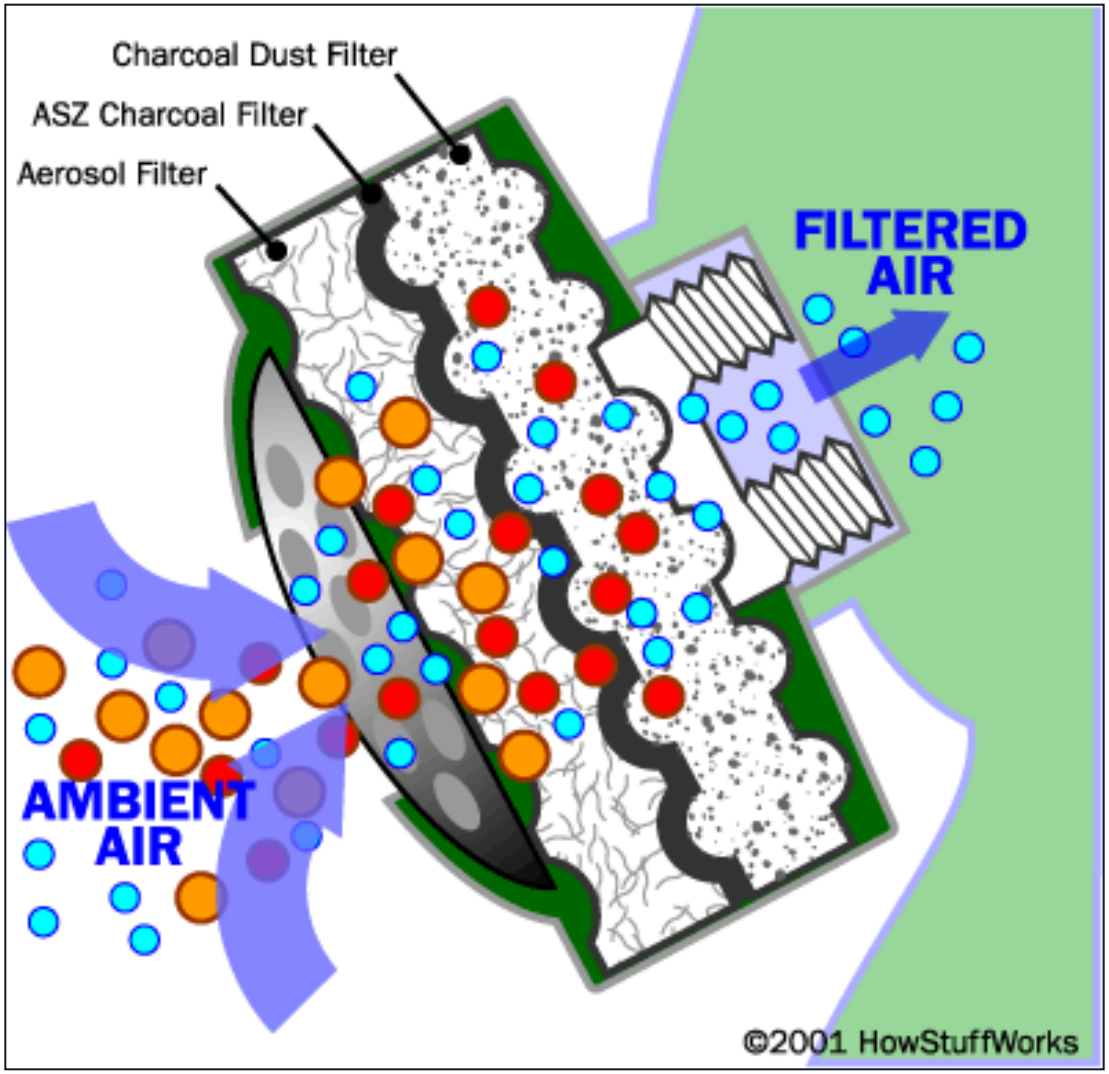
No Skin Hazard

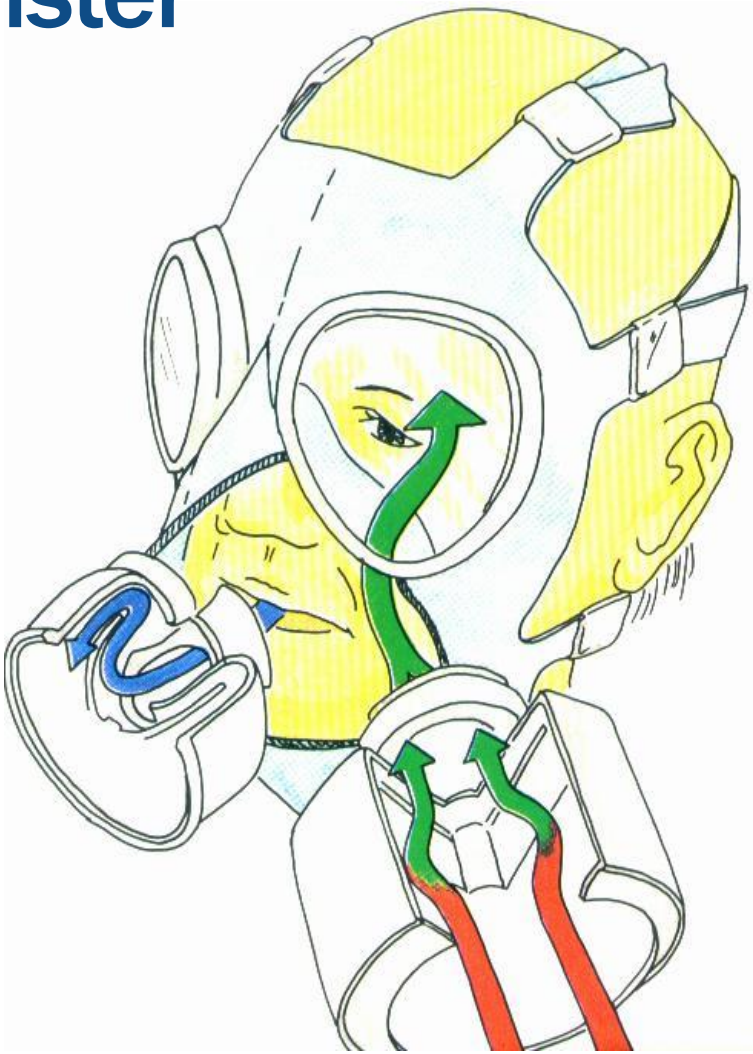
# OPCW Protective Clothing Levels

**PCL 2**

No Skin Hazard - Respiratory Hazard

# The Filter Canister



# OPCW Protective Clothing Levels

## PCL 3

No Skin Hazard -
Respiratory Hazard

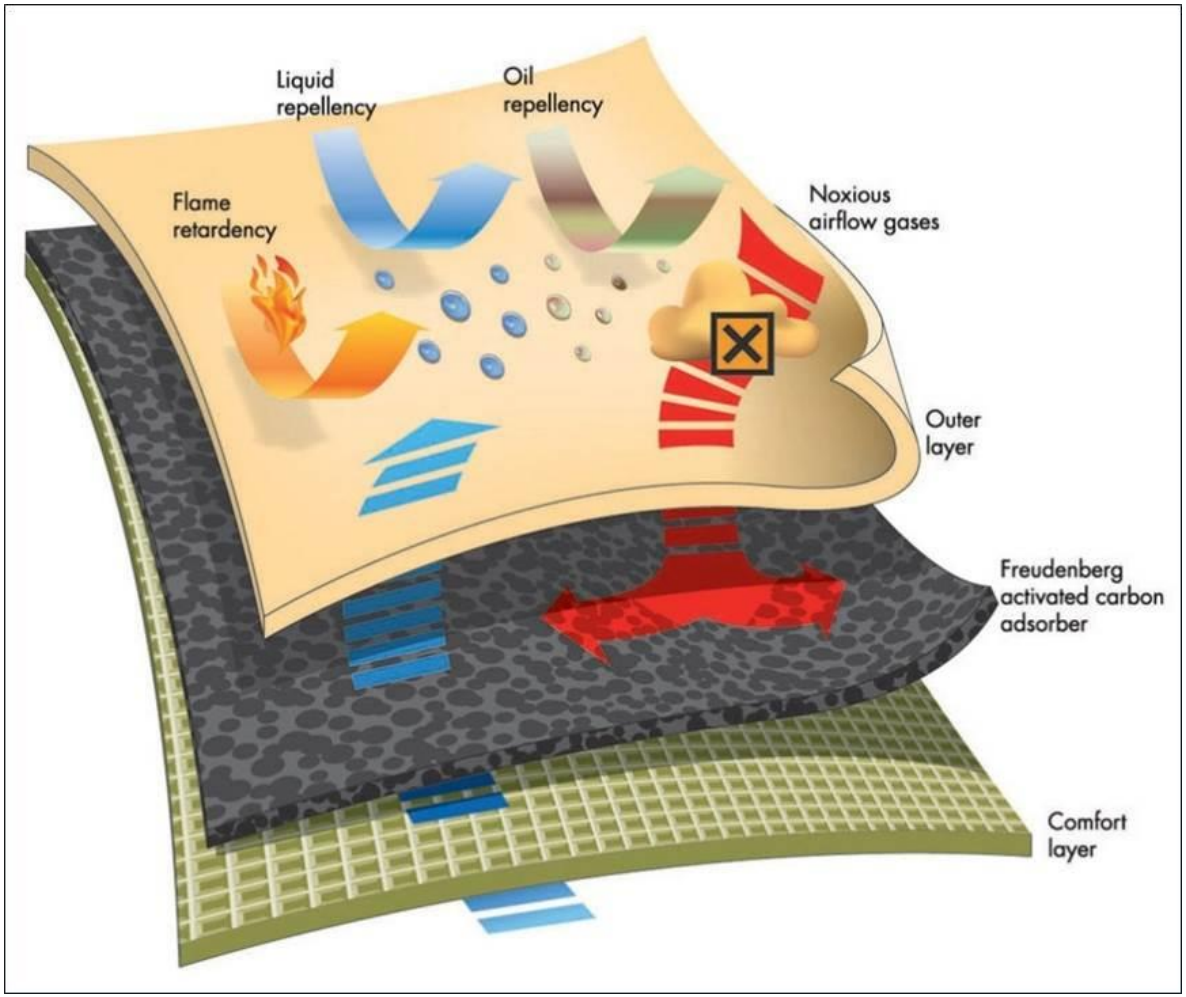
# OPCW Protective Clothing Levels

PCL 4

Skin Hazard - Respiratory hazard

PCL 4 -

# Air permeable fabric



# Welcome Mike.....

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

# Welcome Mike.....

# Gloves

# Your turn

3 pin plugs: Change the Fuse!.....

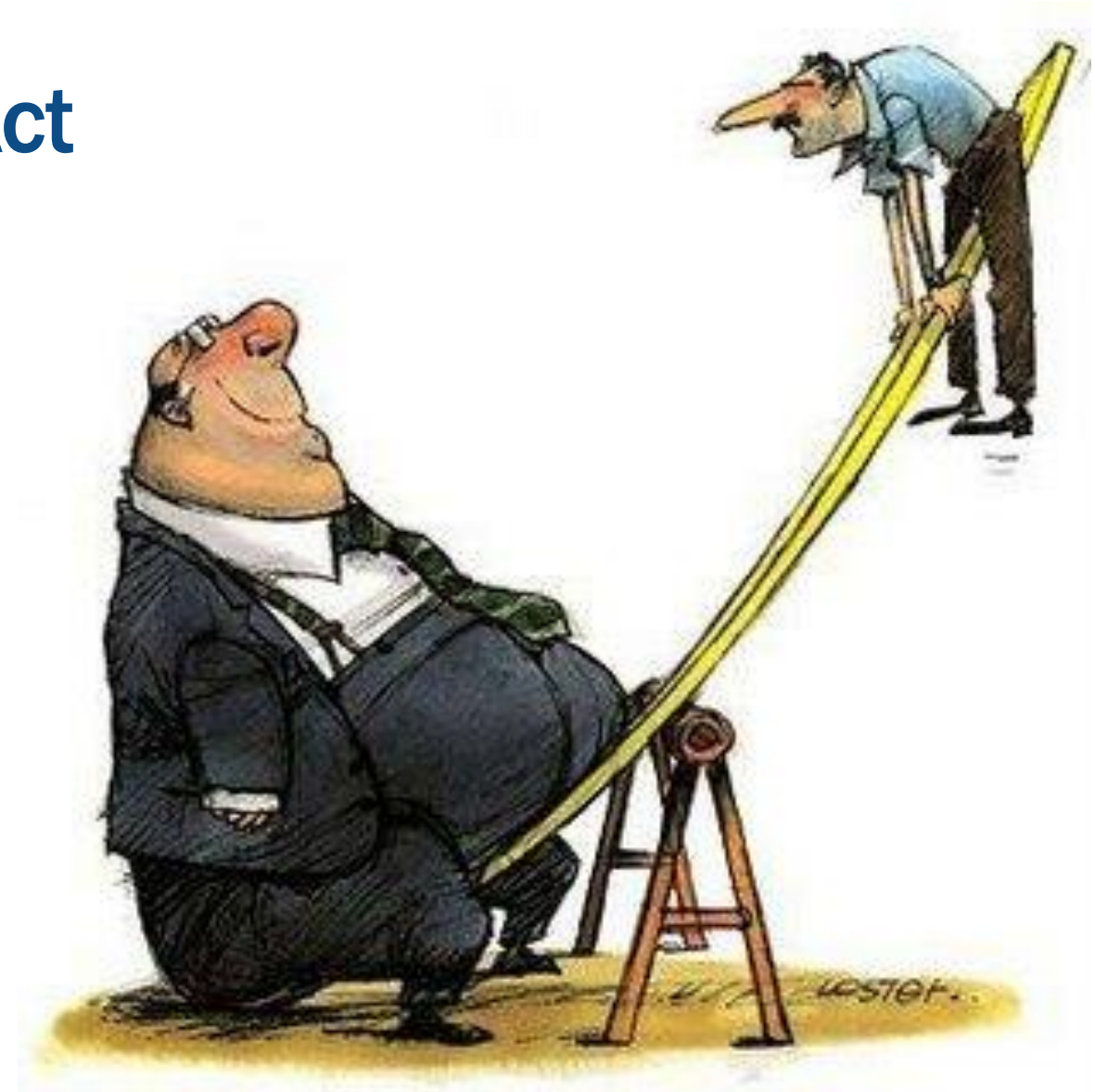
Prize

National pride

# From the Perspective of an Inspector...

# A Balancing Act

- Striking a Balance between High Protection and Low Burden
- Can Science and Technology help redress the balance?



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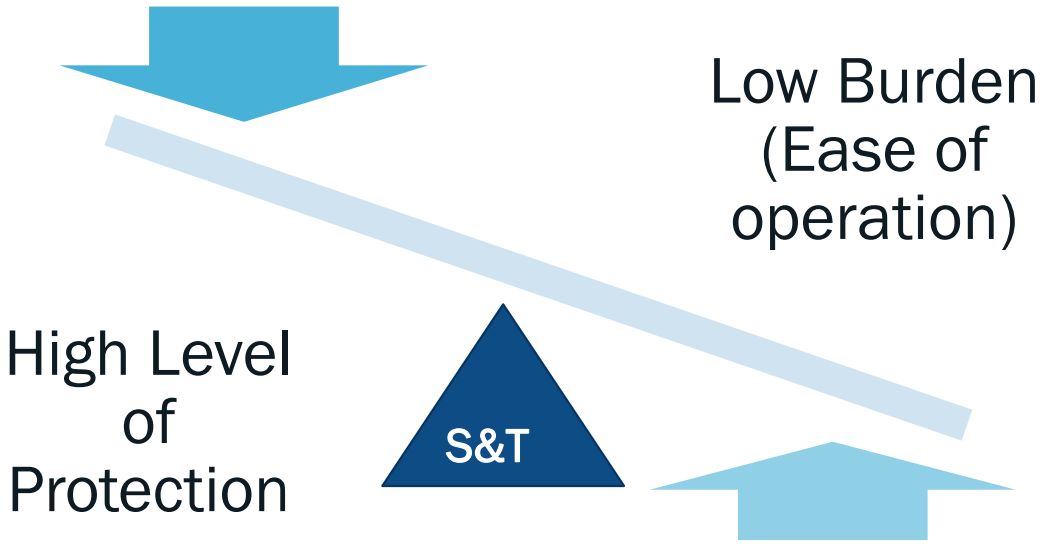
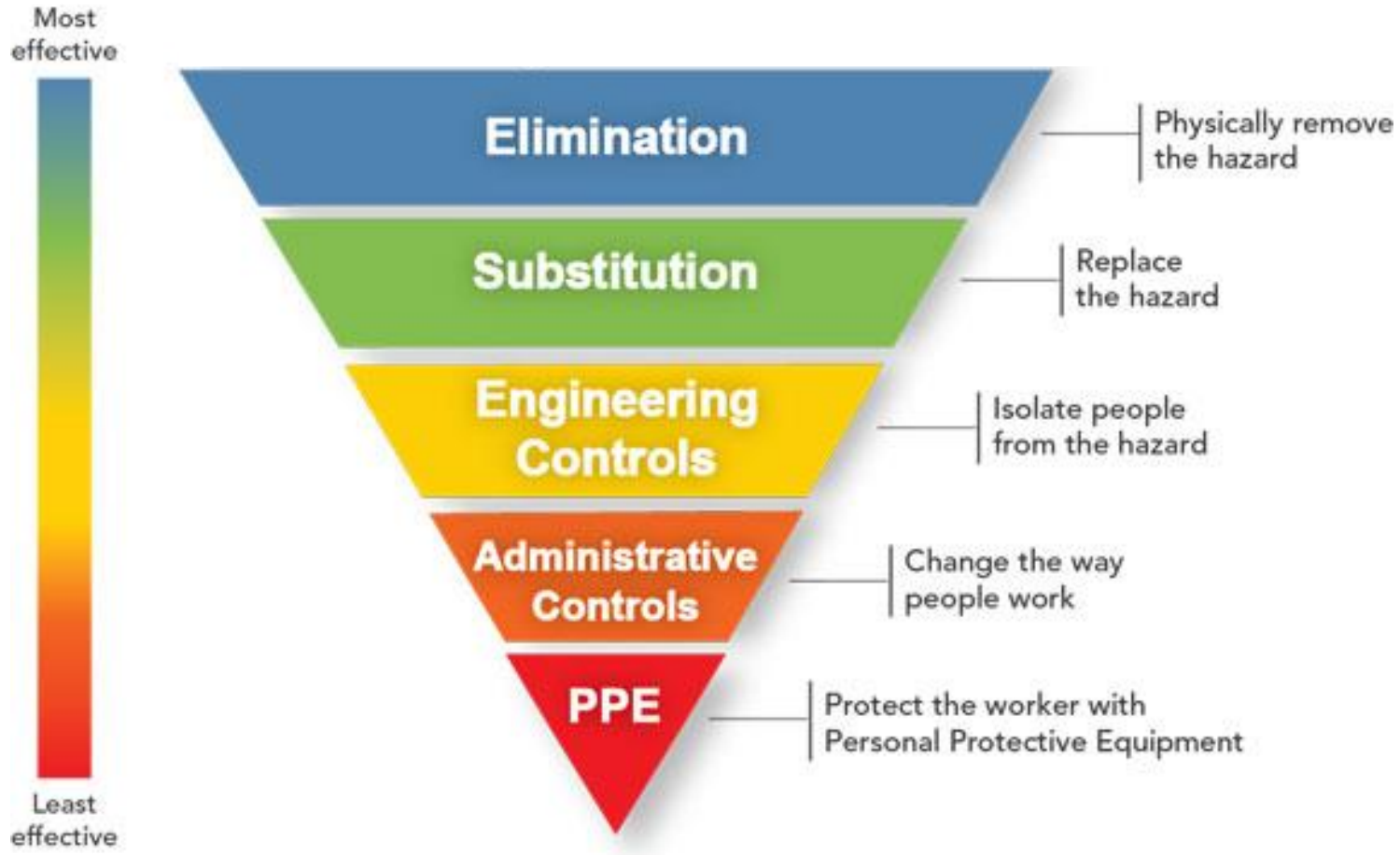


# Knowledge Check

1. Hazard controls must be addressed in which order of priority?
   a. Substitution, PPE, workaround, and administrative
   b. Workaround, stop work, PPE, elimination and engineering
   c. Elimination, PPE, engineering, and substitution
   d. Elimination, substitution, engineering, administrative, and PPE

# Participant Quiz Results

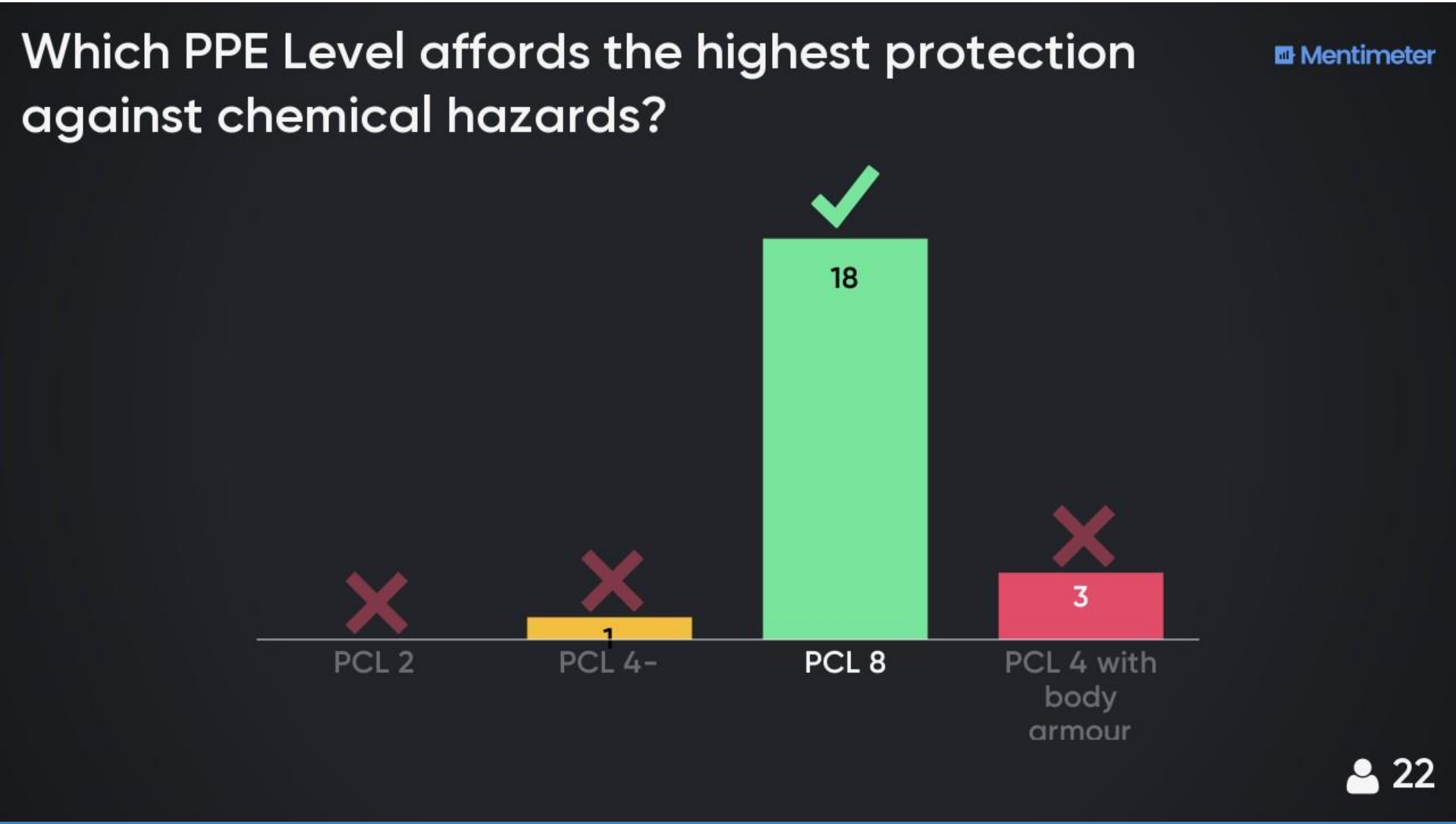
# Hierarchy of Controls



# Knowledge Check

2. 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

# Participant Quiz Results



C

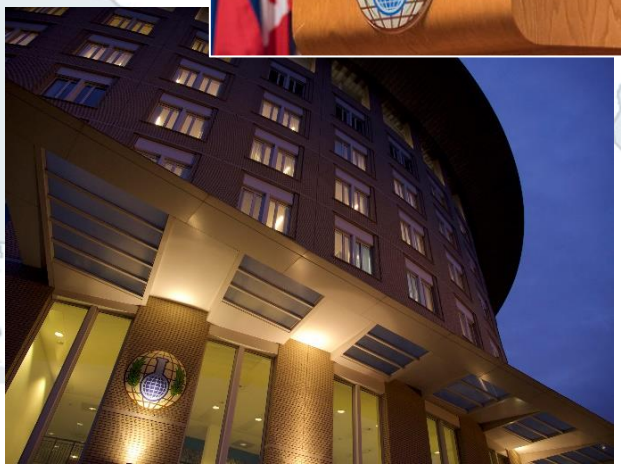
## PCL 8

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

# Closing Remarks

# Who are the Science Advice Beneficiaries?


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



# Who are the Science Advice Beneficiaries?

**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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Indep
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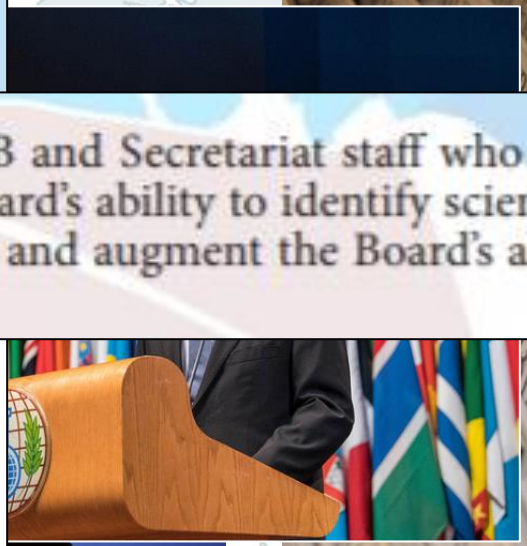
tance of separating technological possibility from demonstrated technological capability.

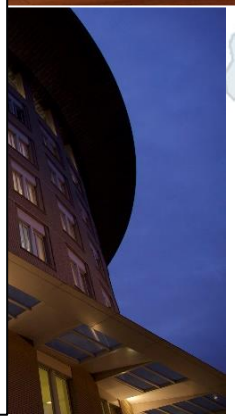
- In view of the increasingly interdisciplinary nature of advances in science and technology relevant to the Convention, the SAB should continue to build close working relationships with relevant professional societies and science advisory bodies of other relevant international organisations to enable 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.

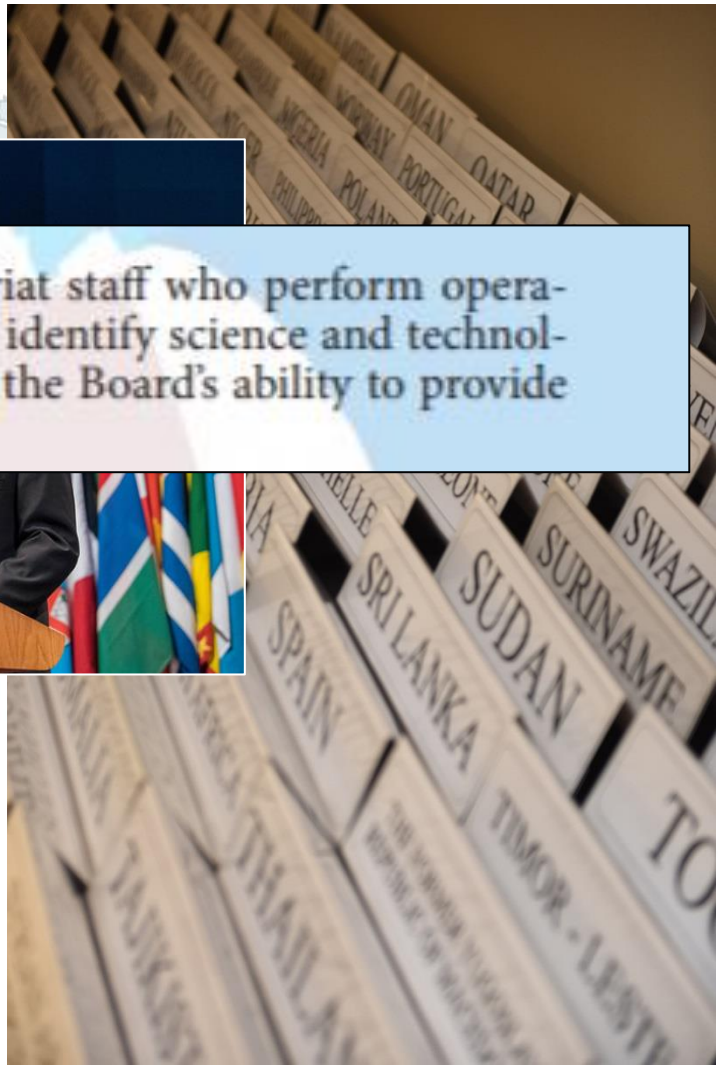
ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

*Working together for a world free of chemical weapons*

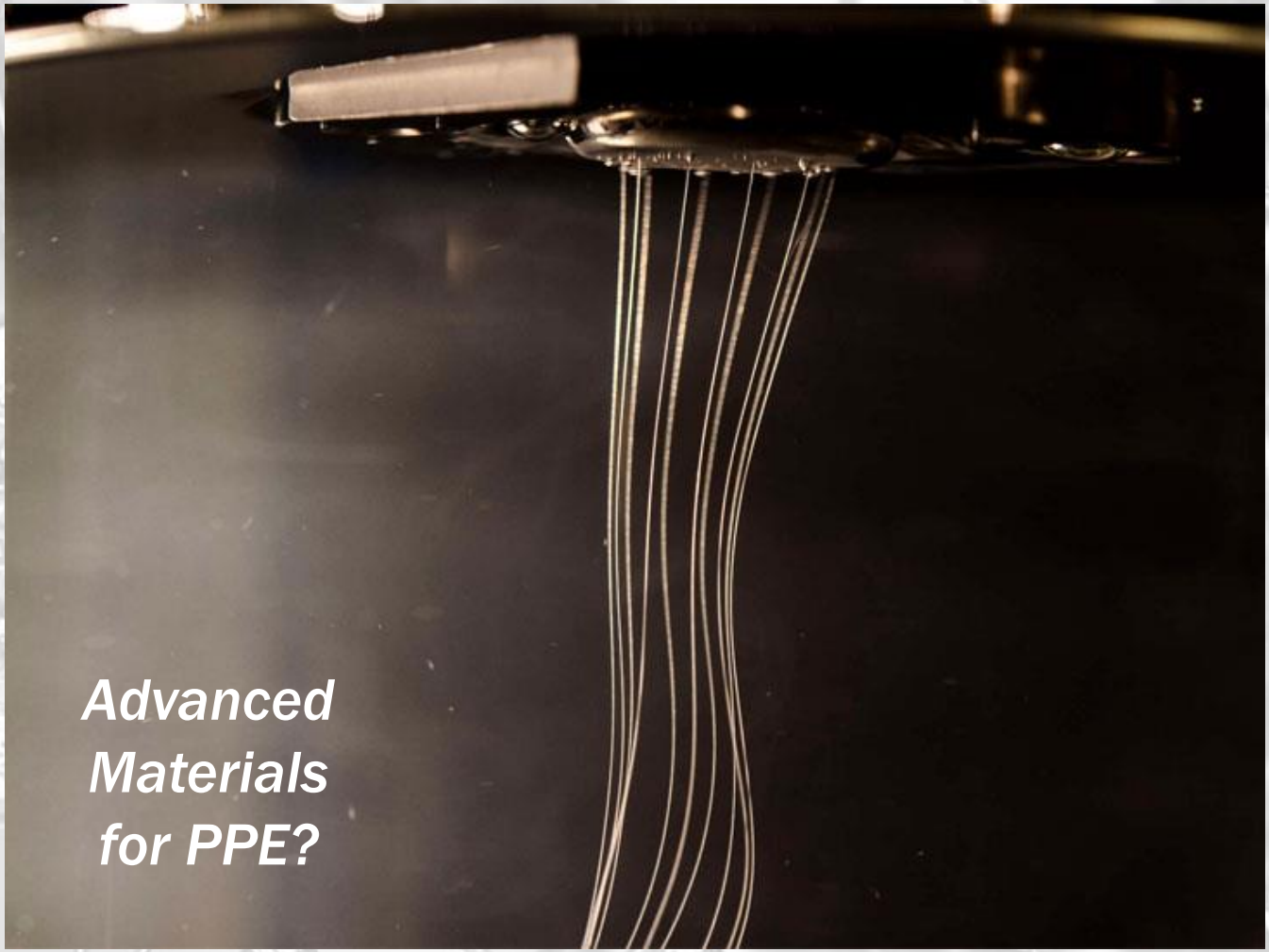
/OPCW @OPCW @OPCW_ST /OPCWONLINE /OPCWONLINE /OPCW/COMPANY







# Understand both the Needs and the Possibilities



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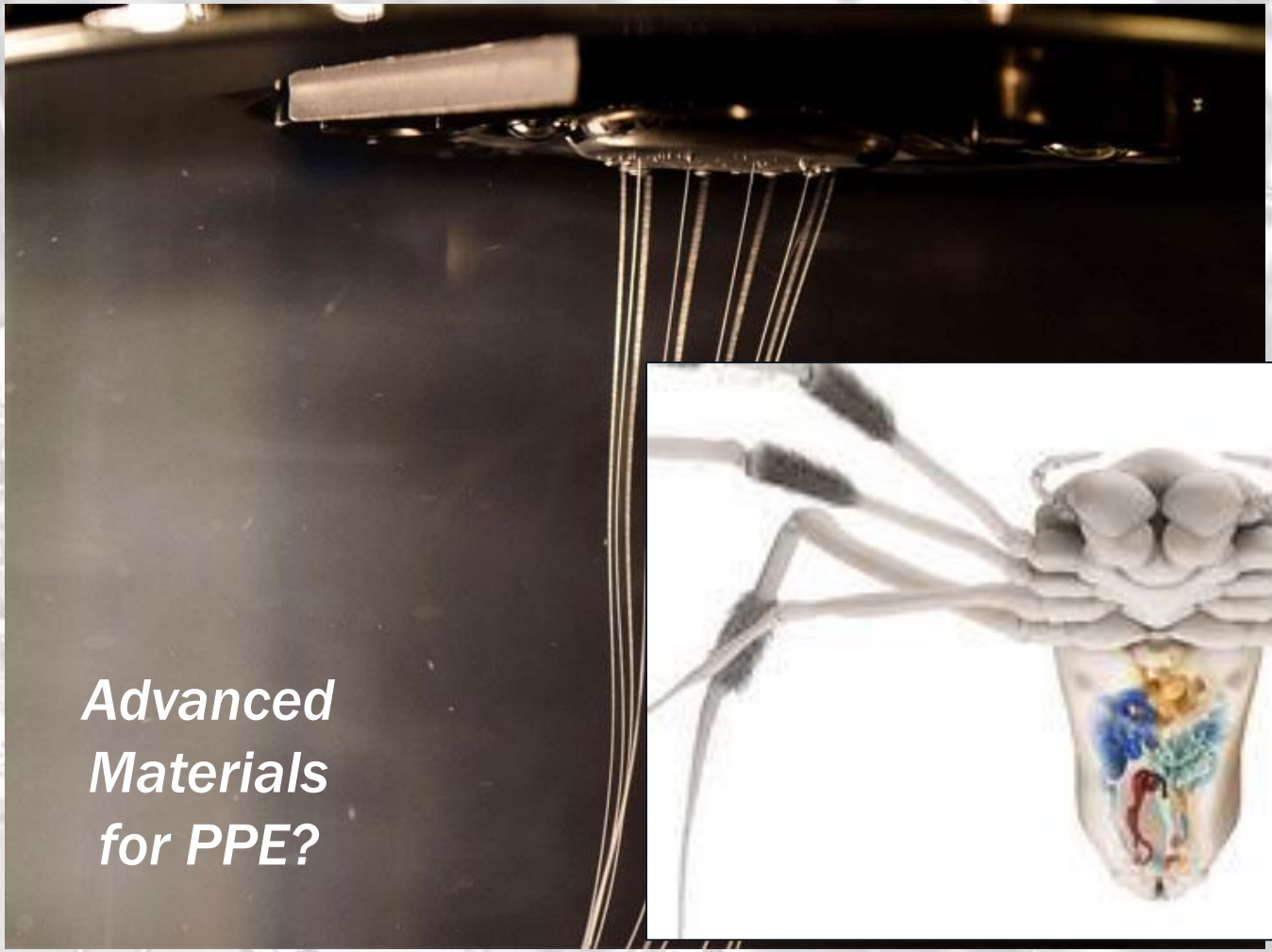




http://www.sciencemag.org/news/2017/10/spinning-spider-silk-startup-gold

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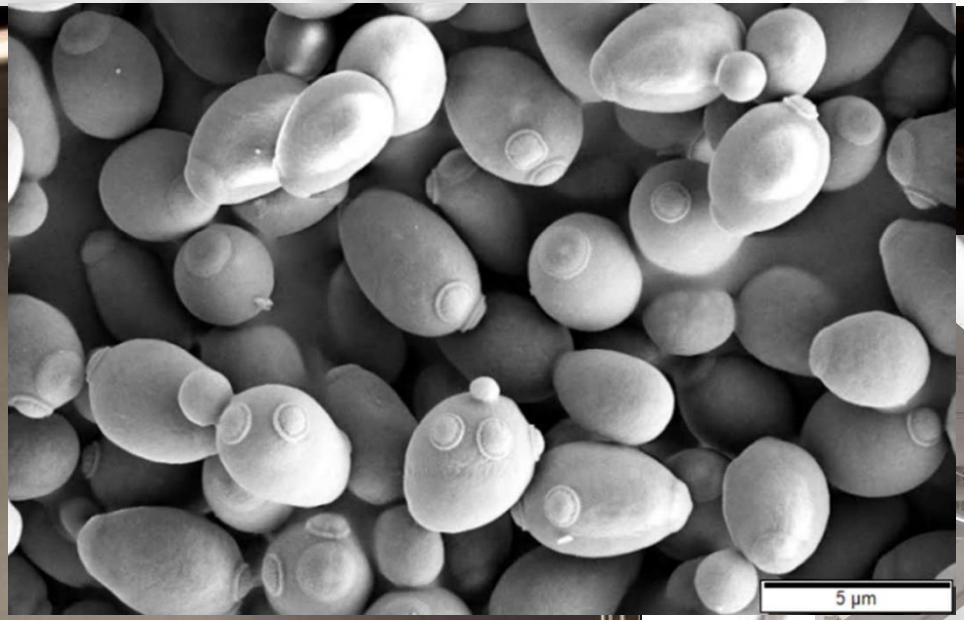
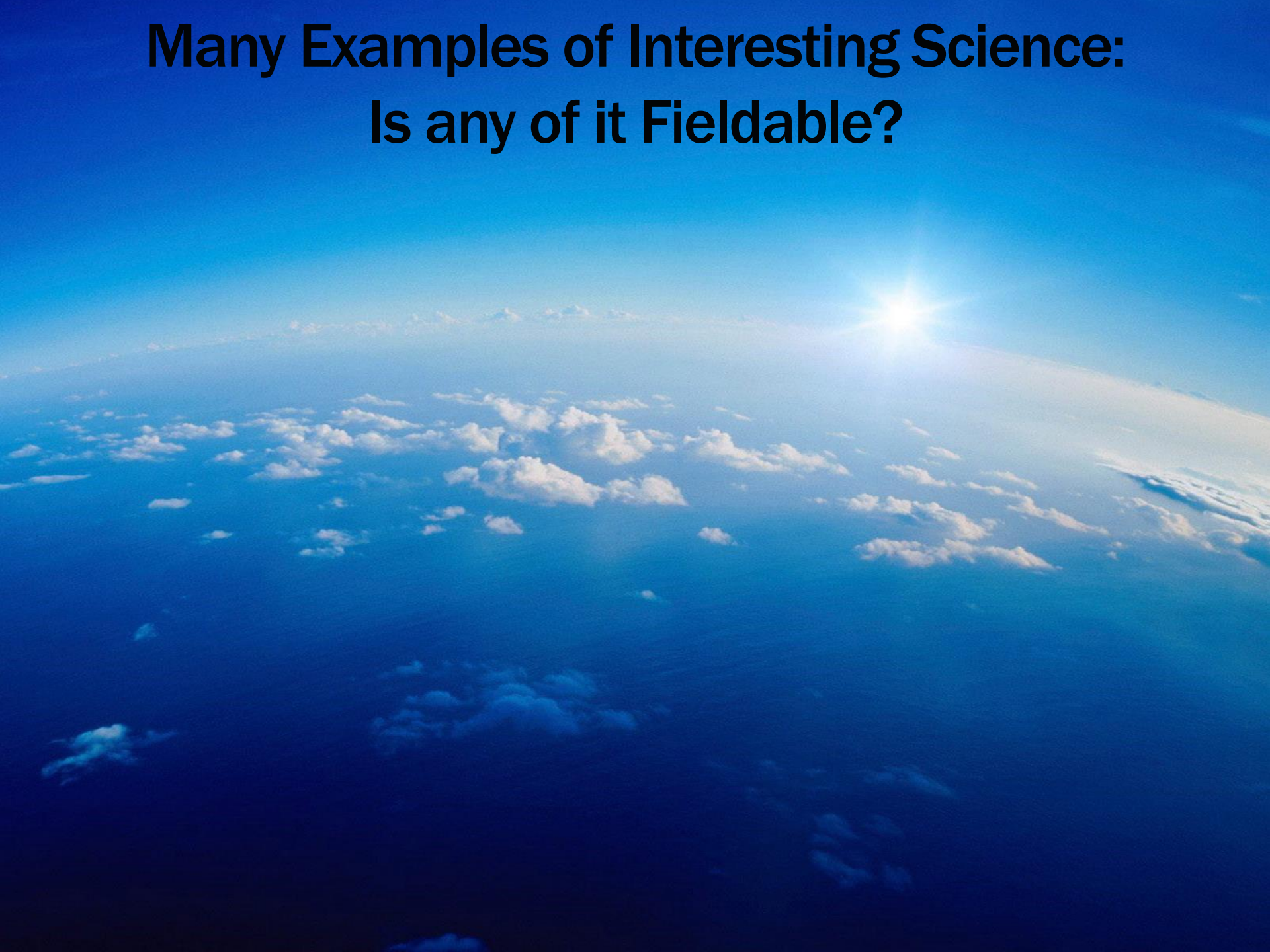



*Advanced Materials for PPE?*

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

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



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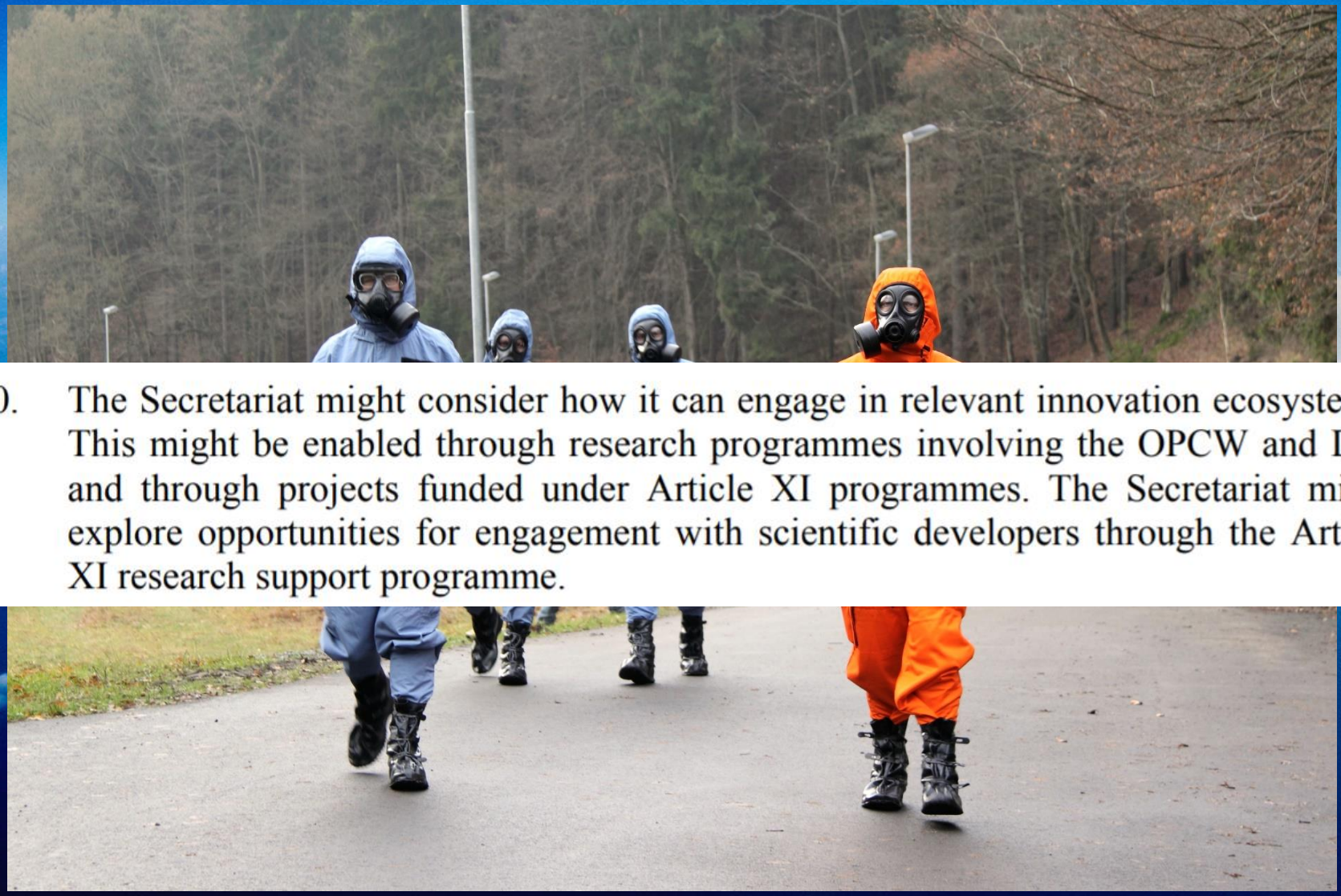

350. The Secretariat might consider how it can engage in relevant innovation ecosystems. This might be enabled through research programmes involving the OPCW and DLs and through projects funded under Article XI programmes. The Secretariat might explore opportunities for engagement with scientific developers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

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

# Next Stop: The Fourth Review Conference

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IUPAC

International Union of Pure and Applied Chemistry

# Next Stop: The Fourth Review Conference

Brief

**ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS**

Working Together For a World Free of Chemical Weapons

## Temporary Working Group on Investigative Science and Technology

Reporting to the Scientific Advisory Board (SAB), the Temporary Working Group (TWG) will in particular consider the following questions:

**Question 1:**
Which methods and capabilities used in the forensic sciences could usefully be developed and/or adopted for Chemical Weapons Convention-based investigations?

**Question 2:**
What are the best practices and analysis tools used in the forensic sciences for effectively cross-referencing, validating, and linking toge investigation sites, materi individuals interviewed?

**Question 3:**
What are the best practices for management of data

**Question 4:**
What are the best practices for the collection, handling, curation and storage, and annotation of evidence?

**Question 5:**
Which technologies and established or new) non-destructive measureme help guide evidence collecti

**Question 7:**
Which methods are available (or are being developed) for the sampling and analysis of environmental and biomedical materials and can be used in the detection of toxic industrial chemicals relevant to the Chemical Weapons Convention?

**Question 8:**
Which technologies and established or new) can be custody and verifying authen digital images and video rec

**Question 10:**
Do collections of physical objects, samples, and other information for chemical weapons-related analysis exist and can they be made available to investigators for retrospective review? How might these collections be used to support investigations?

**Question 11:**
Are there stakeholders tha could usefully engage with t on investigative matters?

@opcw
@opcw_st
/opcwonline
/opcwonline

IUPAC

International Union of Pure and Applied Chemistry

# Next Stop: The Fourth Review Conference

Brief

ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Working Together For a World Free of Chemical Weapons

Temporary Working Group on Investigative Science and Technology

IUPAC

International Union of Pure and Applied Chemistry

# OPCW

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