21 February 2022

Strengthening the Web of Prevention against Chemical and Biological Weapons

Cartoon Series

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Facilitation Notes

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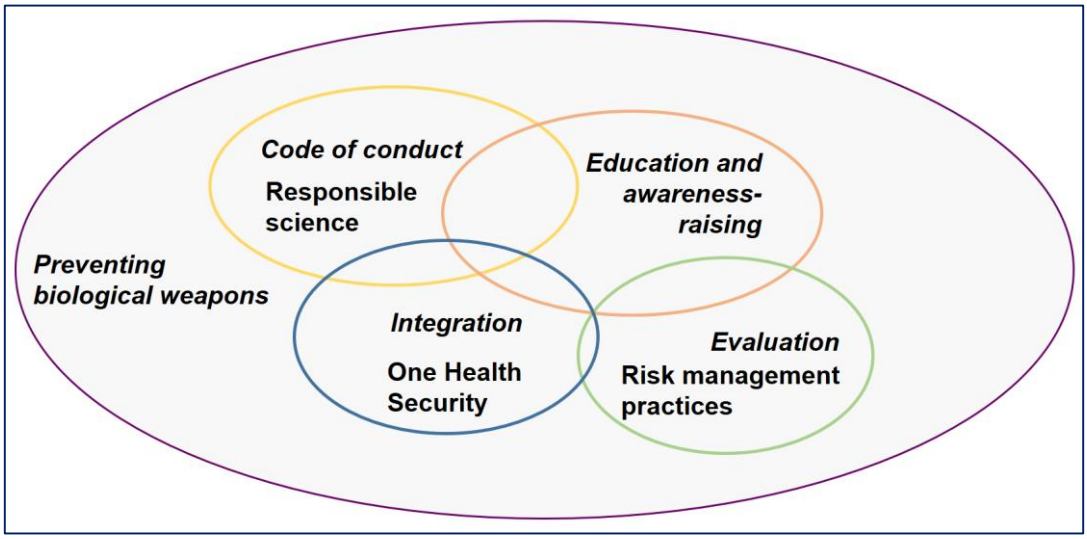
Scope and Purpose of the Facilitation Notes

The purpose of these facilitation notes is to demonstrate how the cartoon series *Strengthening the Web of Prevention against Chemical and Biological Weapons* could be used to promote reflection on biological and chemical security issues in the context of science practice. Advances in life sciences and chemistry offer capabilities that could facilitate the development of novel and more sophisticated biological and chemical weapons. Security risk management is an essential element of the process of safeguarding benignly intended research and innovation from accidental or deliberate misuse in the 21st century. The facilitation notes draw attention to indicative aspects of the process of identifying and addressing dual-use issues in life sciences and chemistry. In this context, the cartoons could serve as situational scenarios for promoting consideration of biological and chemical security concepts.

The cartoon series comprises five two-page cartoons successively addressing Preventing biological weapons, Codes of conduct, Education and awareness-raising, Evaluation, and Integration. The facilitation notes suggest indicative topics that could be discussed using the cartoons (Figure 1). Cartoon 1 titled "Preventing biological weapons" could be used to discuss the issue of 'dual use' in life sciences and chemistry as it relates to the Biological and Toxin Weapons Convention (BTWC) and the Chemical Weapons Convention (CWC). Cartoon 2 titled "Codes of conduct" could be used to discuss professional standards for responsible science conduct and their relevance to dual-use research. Cartoon 3 titled "Education and awareness-raising" could be used to discuss indicative strategies for engaging scientists with dual-use issues. Cartoon 4 titled "Evaluation" could be used to discuss indicative strategies for dual-use risk management in science research. And Cartoon 5 titled "Integration" could be used to discuss dual-use risk management as it relates to 'one health' security.

Figure 1: Cartoon series: suggested topics for consideration



Source: Author

The cartoon series has been translated into 12 languages: Arabic, Armenian, Chinese, French, German, Greek, Italian, Japanese, Russian, Spanish, Ukrainian, and Urdu. All cartoon series versions are freely available via the London Metropolitan University Repository (see Annex A for accessing the English copies of the cartoons).

The development of the facilitation notes is informed by earlier works on the use of cartoons in science education. Examples include the comic books *Adventures in Synthetic Biology* by Chuck Wadey et al. published in 2005 and *The Cartoon Guide to Genetics* by Larry Gonick and Mark Wheelis that first appeared in 1983. The cartoon format has also been used to communicate biological security issues.

The facilitation notes provide guiding tips for using the cartoon series for awareness-raising and training. The facilitation notes are organised into 5 sections. Each section focuses on a suggested topic for consideration. This topic is described in brief and mapped out using a step-by-step overview of each cartoon. The notes are not prescriptive or exhaustive; rather, they are intended to provide a generic framework for engaging stakeholders in discussion and critical reflection on chemical and biological security and the role that scientists could play in strengthening the existing international norms against chemical and biological weapons.

All scenarios described in the facilitation notes are hypothetical.

Indicative topic for discussion #1: The concept of dual-use research and its relevance to the Biological and Toxin Weapons Convention (BTWC) and the Chemical Weapons Convention (CWC)

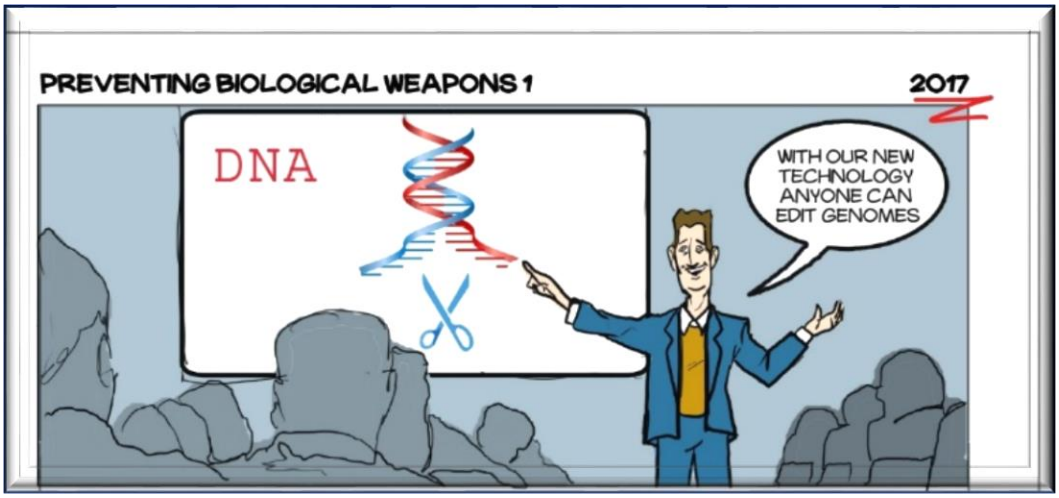
Introduction

Cartoon #1, Preventing biological weapons could be used to discuss the dual-use potential of science and technology. This includes the risk that advances in biology and chemistry could be misused for illicit purposes such as the development of chemical and biological weapons.

Step-by-step topic mapping

Page 1 of this cartoon shows an evolving situation that takes place during a scientific conference. The year is 2017.

Page 1 – http://repository.londonmet.ac.uk/6332/.



Line 1: A scientist is giving a presentation.

Relevance to the suggested topic for discussion: In 2020, Emmanuelle Charpentier and Jennifer A. Doudna received the Nobel Prize in chemistry for their 2012 invention, a methodology for high precision changes to genes, commonly known as CRISPR-Cas9. Jennifer Doudna has advocated for the responsible use of the CRISPR technology underscoring the need to ensure that its benefits are widely accessible and affordable.

Guiding tip: This line could be used to raise awareness of advances in gene editing and their possible applications. It could also be used to start a general discussion on novel advances in chemistry and biology that may have a broad social impact.

Line 2: During a coffee-break, the presenting scientist is approached by a female colleague who seems interested in discussing his talk.

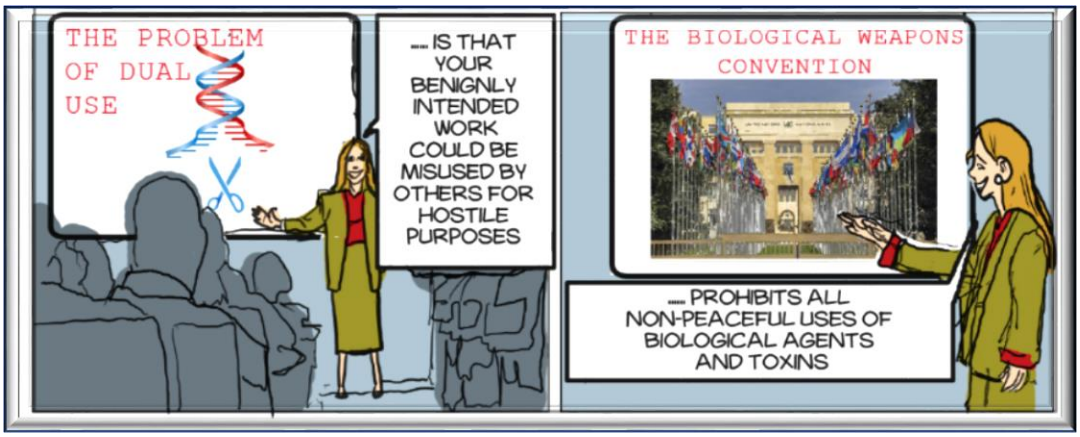
Relevance to the suggested topic for discussion: The image features the cover of a guiding document on responsible conduct of research – Doing Global Science: A Guide to Responsible Conduct in the Global Research Enterprise – that was published by the Inter-Academy Partnership in 2016. Chapter 3, "Preventing the Misuse of Research and Technology" addresses the responsibility of scientists to consider the potential consequences of their work.

Guiding tip: This line could be used for discussing the social, ethical, and legal responsibilities of scientists. For examples on interactive methods for raising awareness of the dual-use implications of advances in science and technology, see Human Brain Project, Team-Based Learning Exercise: Social, ethical, and legal responsibilities of life sciences, 2018; and Human Brain Project, Team-Based Learning Exercise: Social, ethical, and legal responsibilities of life scientists, 2019 (featuring an exercise on CRISPR).

Line 3: The conversation between the two scientists continues.

Relevance to the suggested topic for discussion: Historically, advances in biology and chemistry have been used to develop biological and chemical weapons.

Guiding tip: This line could be used to discuss the mechanisms for the prohibition of biological and chemical weapons, i.e. Biological and Toxin Weapons Convention (BTWC) and the Chemical Weapons Convention (CWC). It can also be used to discuss how these two Conventions might be relevant to gene editing technologies (and other novel advances in biology and chemistry).



Line 4: The female scientist who was previously talking to the presenter is giving a talk.

Relevance to the suggested topic for discussion: In 2017, States Parties to the BTWC decided to hold annual two-day Meetings of Experts on Review of developments in the field of science and technology related to the Convention. The purpose of these Meetings was to (1) identify potential benefits and risks of new science and technology developments relevant to the Convention; (2) consider biological risk assessment and management; and (3) consider the development of voluntary model code of conduct for biological scientists and all relevant personnel, and biosecurity education. The BTWC Meeting of Experts in 2018 was dedicated to the specific topic of genome editing, taking into account the three focus areas described above. Gene editing technologies have also been considered by the Scientific Advisory Board (SAB), a permanent consultative body of the Organisation for the Prohibition of Chemical Weapons (OPCW). The SAB comprises 25 independent experts from different countries and reviews scientific and technological developments relevant to the Chemical Weapons Convention (CWC).

Guiding tip: This line could be used to discuss the benefits and risks of gene editing technologies regarding the implementation of the BTWC and CWC. It could also be used to discuss what arrangements and measures may be required to ensure that gene editing technologies are used only for peaceful purposes.

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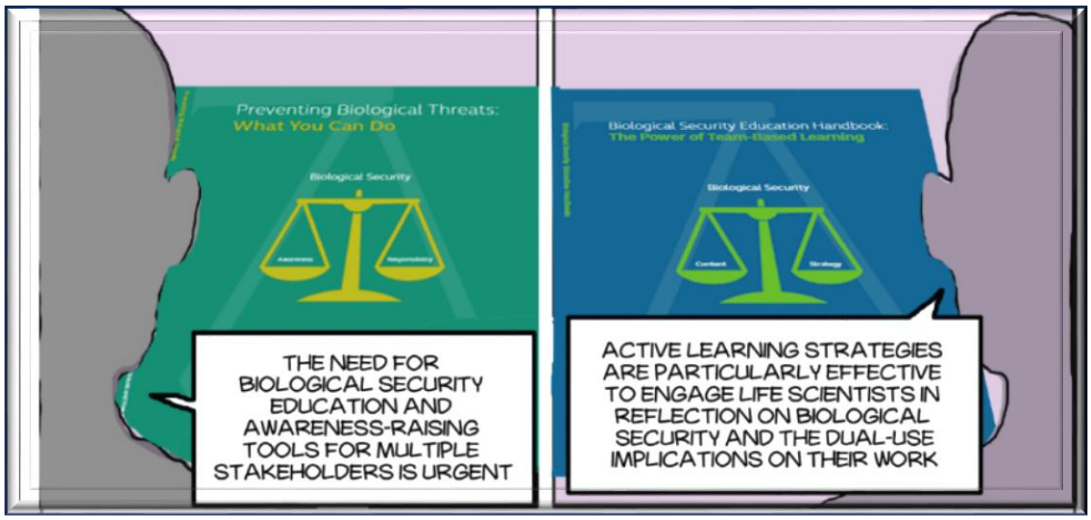
Page 2 of this cartoon shows an evolving situation during a video conference call on safeguarding scientific and technological from deliberate misuse. The year is 2021.

Page 2 – http://repository.londonmet.ac.uk/6333/.

Line 1: The scientist who was presenting about gene editing on page 1 is now participating in a video conference call on the management of dual-use risks in biology and chemistry.

Relevance to the suggested topic for discussion: In 2021, the World Health Organisation (WHO) launched an initiative to develop a Global Guidance Framework to Harness the Responsible Use of Life Sciences. This initiative is part of a broad portfolio of activities aimed at strengthening the governance of dual-use research through stakeholder engagement and global health foresight to identify and connect known and emerging issues in biological security.

Guiding tip: This line could be used to discuss the change in the behaviour of the presenting scientist. During the conference on page 1, he did not seem to be fully aware of the dual-use potential of his work. Four years later, in 2021, he is taking part in discussions on the management of dual-use risks highlighting the importance of engaging science stakeholders in the process of developing risk management arrangements and mechanisms.



Line 2: Participants in the video conference call discuss the role of raising awareness of security risks posed by advances in life sciences and chemistry among scientists.

Relevance to the suggested topic for discussion: The image features the covers of a two-part training resource on biological security. The resource comprises a practical guide titled Preventing Biological Threats: What You Can Do (2015) and an active learning manual titled Biological Security Education Handbook: The Power of Team-Based Learning (2016). It covers a set of biological security core concepts and guidance on the use of active learning strategies with different target audiences. The resource is open-source and has been translated into different languages. The development of the resource builds upon a wide-ranging interdisciplinary research on ethics education and dual-use issues in science and technology. The Advisory Board on Education and Outreach (ABEO), a permanent consultative body of the Organisation for the Prohibition of Chemical Weapons (OPCW) highlighted the value of active learning strategies and tools in its Report on the Role of Education and Outreach in Preventing the Re-Emergence of Chemical Weapons (2018).

Guiding tip: This line could be used to discuss resources, strategies, and tools for engaging science stakeholders with dual-use issues. It could also be used to discuss the impact of education and training activities on science practice.

Line 3: The video presenter is speaking again.

Relevance to the suggested topic for discussion: The COVID-19 pandemic has shown the multifaceted impact that infectious disease outbreaks could have on communities across the globe. It has also demonstrated the difficulties in establishing the origins of novel biological threats.

Guiding tip: This line could be used to discuss the possible effects of disease outbreaks and how these could be mitigated. It could also be used to discuss deliberate biological threats and how such threats could be addressed.

Indicative topic for discussion #2: Dual-use research and professional standards for responsible science

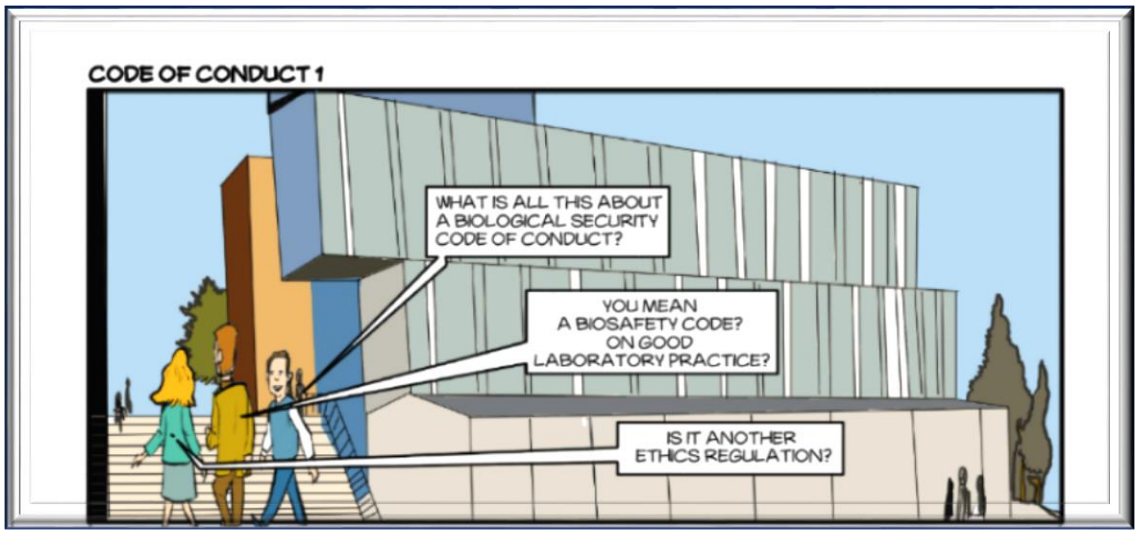
Introduction

Cartoon #2, Codes of conduct could be used to discuss the issue of dual use with relation to professional standards for responsible conduct of science. Codes of conduct are shared systems of principles that professional communities agree to abide by in their everyday practice. Depending on their purpose, professional codes can be aspirational (setting out values and ethical norms), educational/advisory (providing guidelines or suggesting how to act appropriately, also referred to as codes of conduct), or enforceable (setting out rules and procedures, also referred to as codes of practice). A commonly cited example of an aspirational code is the Hippocratic Oath that medical doctors take at the start of their career.

Step-by-step topic mapping

Page 1 of this cartoon follows a conversation between three university academics.

Page 1 – http://repository.londonmet.ac.uk/6399/.

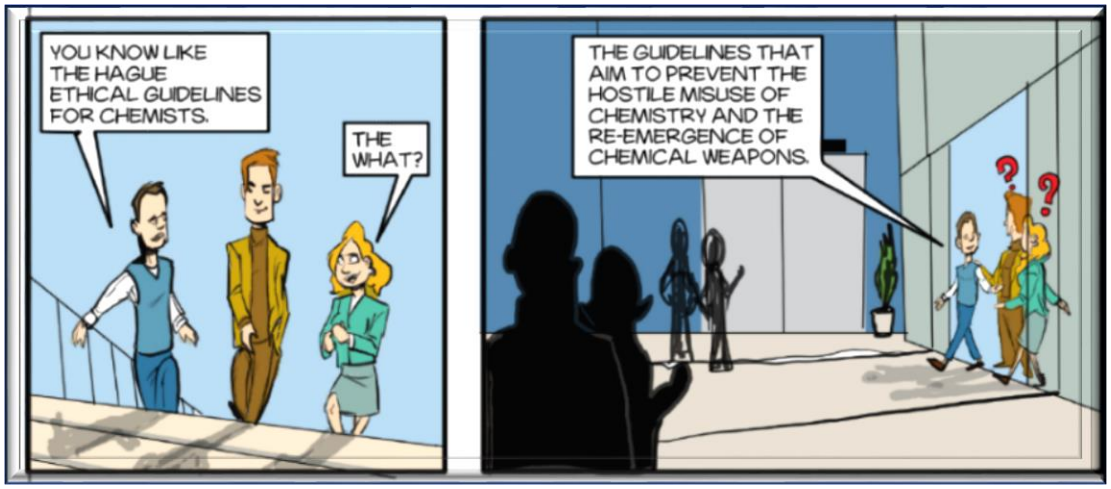


Line 1: The characters meet in front of the main campus building and start a conversation about a code of conduct for biological security.

Relevance to the suggested topic for discussion: In 2005, the Inter-Academy Partnership (IAP) published a Statement on Biosecurity that has been endorsed by more than 60 national science academies. The Statement addresses the dual-use potential of life sciences and the risk of misuse for hostile purposes. It sets out five core elements that can be used for formulating national or institutional codes of conduct for biological security: awareness; safety and security; education and information; accountability; and oversight. In 2021, the IAP endorsed the Tianjin Biosecurity Guidelines for Codes of Conduct of Life Scientists which focus on preventing the misuse of bioscience research without hindering beneficial outcomes, in

accordance with the articles and norms of the Biological and Toxin Weapons Convention (BWC), and in advancement of progress towards achieving the UN Sustainable Development Goals.

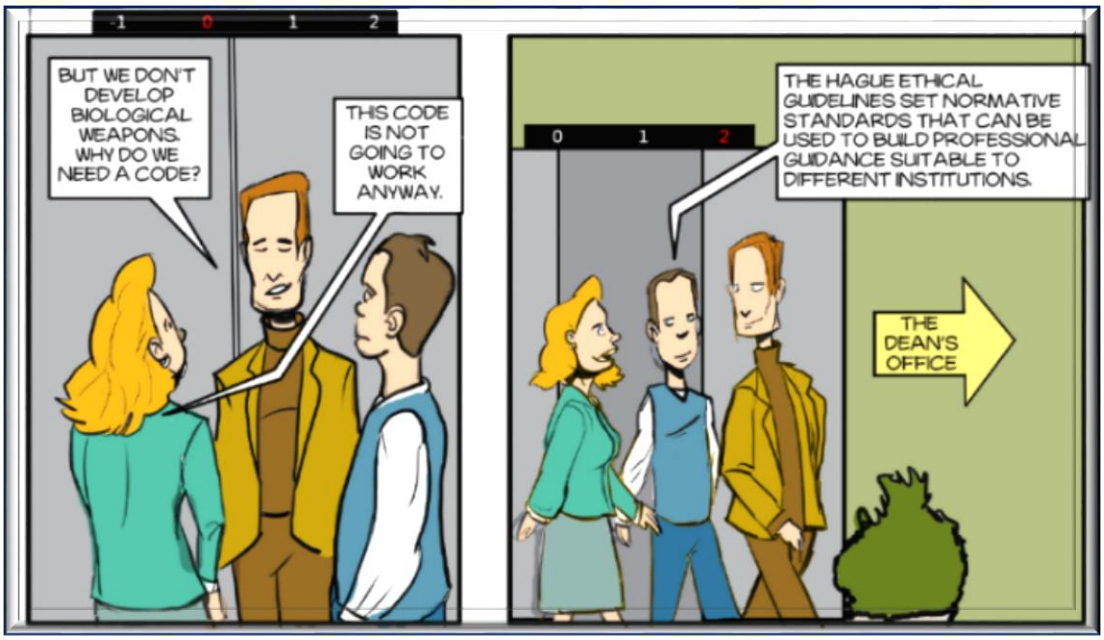
Guiding tip: This line could be used to discuss the role of professional codes for life scientists and how such codes could contribute to the management of safety and security concerns at the workplace. It could also be used to discuss the types of rules, procedures, guidelines, and ethical norms with which life science professionals are expected to comply in their everyday work.



Line 2: The three academics continue their conversation as they enter the university building.

Relevance to the suggested topic for discussion: The Hague Ethical Guidelines were established in 2015 in support of the Chemical Weapons Convention (CWC). The Guidelines were developed by chemical practitioners from around the world and are intended to serve as elements for professional codes and discussion points for ethical issues related to the practice of chemistry under the Convention. Under these Guidelines, "achievements in the field of chemistry should be used to benefit humankind and protect the environment."

Guiding tip: This line could be used to discuss the elements that a code of conduct for biological security could contain. The following Jigsaw exercise (available in the section on 'Teaching Materials' of the Hague Ethical Guidelines webpage) could be used in conjunction with the Tianjin Biosecurity Guidelines.



Line 3: The three academics continue their conversation in the lift. They are heading in the direction of the Office of the Dean of the School of Life Sciences.

Relevance to the suggested topic for discussion: One of the academics is already familiar with the Hague Ethical Guidelines whereas his colleagues are sceptical of the utility of a code of conduct.

Guiding tip: This line could be used to discuss how codes of conduct for biological and chemical security could complement existing requirements, procedures, and practices for risk management in research. It could also be used to consider the pros and cons for introducing a biological / chemical security code of conduct, as well as the potential challenges to the practical implementation of such codes.

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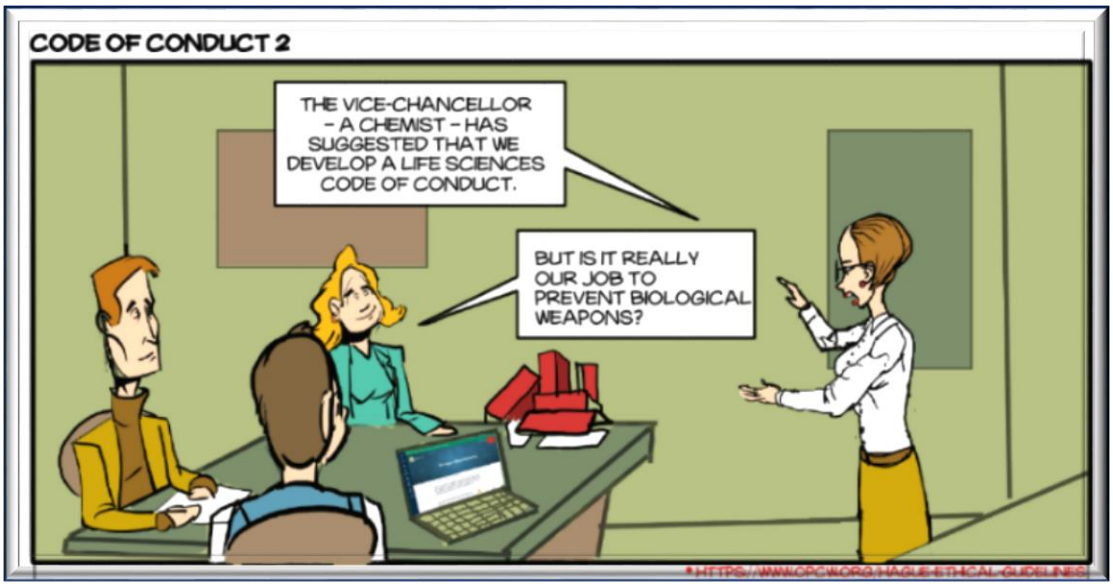
Page 2 of this cartoon shows a meeting between the three academics (page 1) and the Dean of the School of Life Sciences.

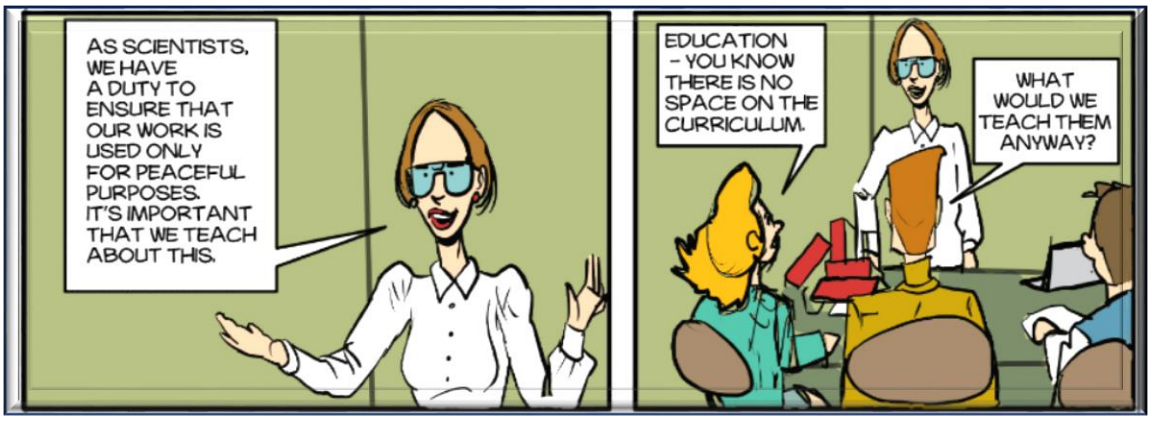
Page 2 – http://repository.londonmet.ac.uk/6400/.



Line 1: A meeting is taking place in the Dean's office.

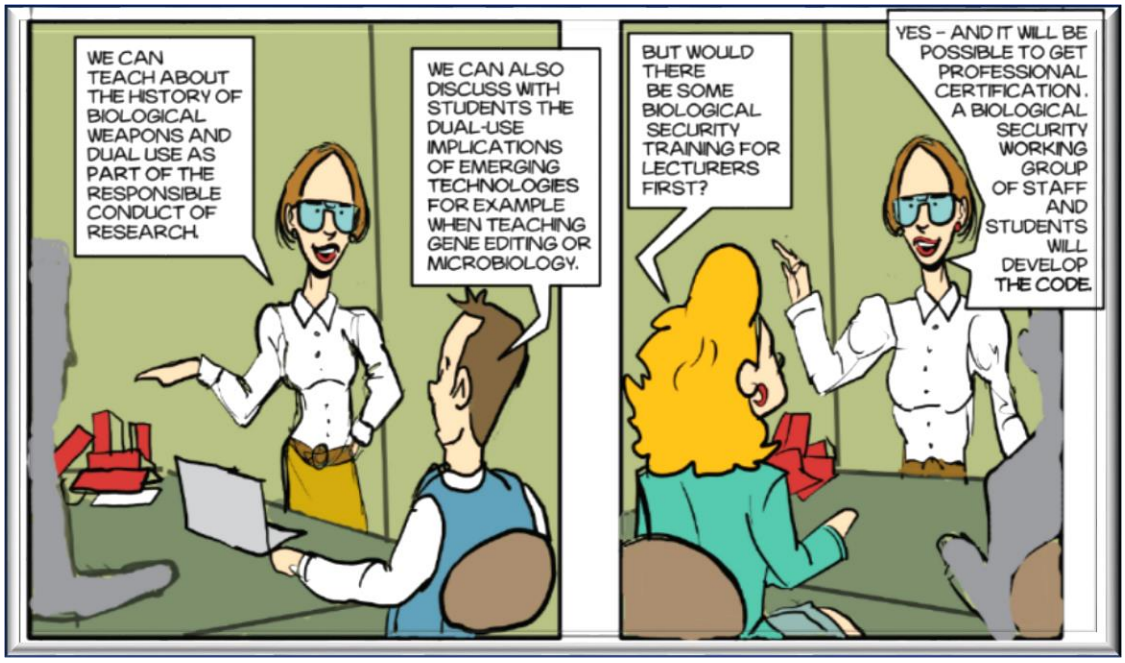
Relevance to the suggested topic for discussion: The development and implementation of institutional policies, procedures, and guidelines in organisations requires leadership.

Guiding tip: This line could be used to discuss the role that senior management at academic and research institutions – Vice-Chancellors, Deans, Heads of Laboratories, Heads of Departments, etc. – could play in promoting institutional engagement with chemical and biological security issues. It could also be used to discuss how bottom-up initiatives could inform institutional decision-making on chemical and biological security issues.



Line 2: The meeting continues.

Guiding tip: This line could be used to discuss the extent to which biological and chemical security issues are considered as part of science education and continued professional development courses for scientists. It could also be used to discuss what resources or training opportunities are available to scientists in the field of biological and chemical security.



Line 3: The meeting continues.

Relevance to the suggested topic for discussion: In 2016, the International Federation of Biosafety Associations (IFBA) launched the first comprehensive international programme for Certification of Biorisk Management Professionals. The programme covers different technical competencies for ensuring safe, secure, and responsible practice in life science research settings around the world. Certification exams cover both biosafety and biosecurity aspects, as well as management of dual-use issues in life sciences.

Guiding tip: This line could be used to discuss the process of developing an institutional / faculty code of conduct for chemical / biological security. It could be used to consider what measures may be necessary to maintain awareness of the code over time and ensure that it is effectively implemented in everyday practice.

Indicative topic for discussion #3: Possible strategies for engaging scientists with biological and chemical security issues

Introduction

Cartoon #3, Education and awareness-raising could be used to discuss indicative strategies for engaging scientists with biological and chemical security issues.

Step-by-step topic mapping

Page 1 of this cartoon presents two different situations. Line 1 and 3 follow a conversation between the Dean of the School of Life Sciences (Cartoon 2) and a university life science lecturer / researcher who is chairing the Life Sciences Committee on Biological and Chemical Security Education. Line 2 shows on the work of the Committee.

Page 1 - http://repository.londonmet.ac.uk/6428/.

Line 1: A meeting is taking place in the office of the Dean of the School of Life Sciences (Cartoon #2).

Relevance to the suggested topic for discussion: Both the Hague Ethical Guidelines and the Tianjin Biosecurity Guidelines for Codes of Conduct for Scientists discussed in conjunction with Cartoon #2 highlight the value of education and awareness-raising in promoting chemical and biological security. The Hague Ethical Guidelines contain the following elements:

Education: "Formal and informal educational providers, enterprise, industry and civil society should cooperate to equip anybody working in chemistry and others with the necessary knowledge and tools to take responsibility for the benefit of humankind, the protection of the environment and to ensure relevant and meaningful engagement with the general public."

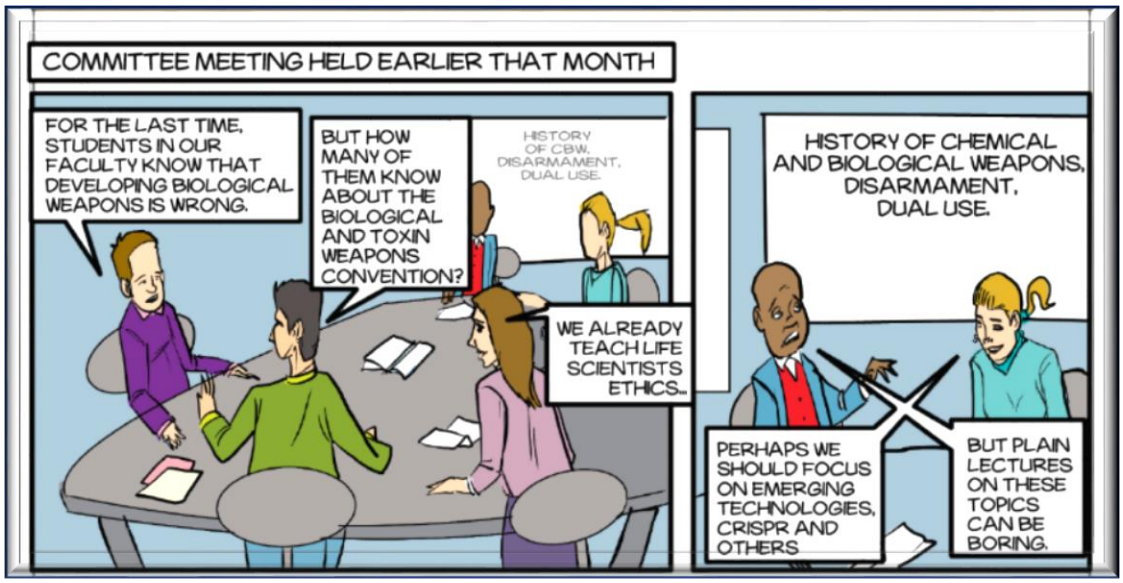
Awareness and Engagement: “Teachers, chemistry practitioners, and policymakers should be aware of the multiple uses of chemicals, specifically their use as chemical weapons or their precursors. They should promote the peaceful applications of chemicals and work to prevent any misuse of chemicals, scientific knowledge, tools and technologies, and any harmful or unethical developments in research and innovation. They should disseminate relevant information about national and international laws, regulations, policies and practices.”

The Tianjin Biosecurity Guidelines contain the following elements:

Education and Training: “Scientists, along with their professional associations in industry and academia, should work to maintain a well-educated, fully trained scientific community that is well versed in relevant laws, regulations, international obligations and norms. Education and training of staff at all levels should consider the input of experts from multiple fields, including social and human sciences, to provide a more robust understanding of the implications of biological research. Scientists should receive ethical training on a regular basis.

Public Engagement on Science and Technology: “Scientists and scientific organisations should play an active role in encouraging public understanding and interest in biological science and technology, including its potential benefits and risks. They should communicate scientific facts and address concerns, uncertainties and misunderstandings to maintain public trust. Scientists should advocate for peaceful and ethical applications of the biosciences and work collectively to prevent misuse of biological knowledge, tools, and technologies.”

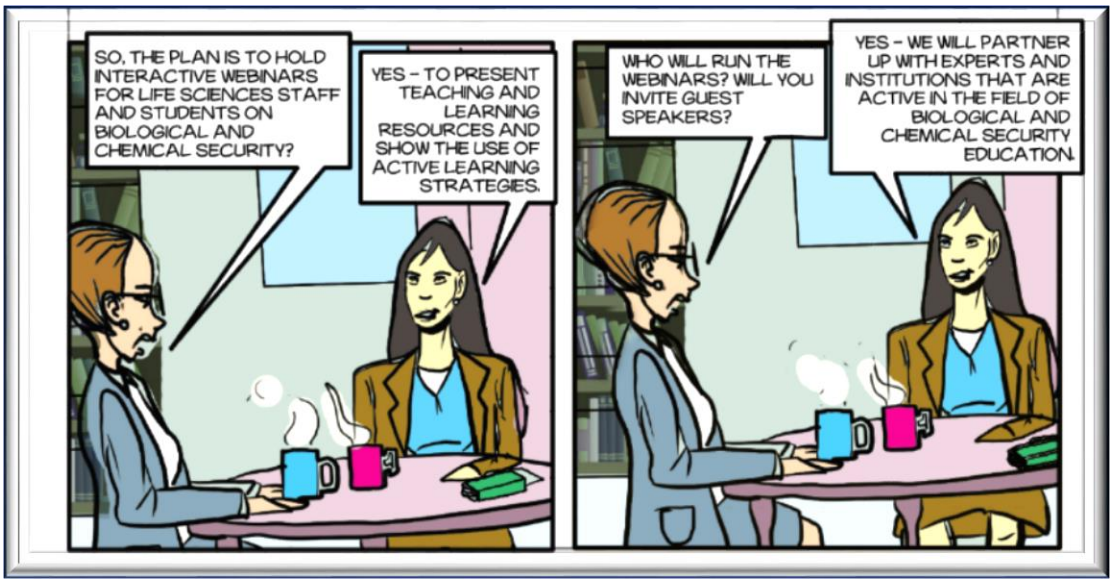
Guiding tip: This line could be used to discuss the extent to which biological and chemical security issues are included in the education and professional development training of scientists (e.g. in courses on ethics and responsible conduct of research). It is also possible to discuss the extent to which scientists should be familiar with biological and chemical security issues and which relevant topics might be of greatest interest / practical value to them.



Line 2: A meeting of the Life Sciences Committee on Biological and Chemical Security Education is in progress.

Relevance to the suggested topic for discussion: There is no internationally approved curriculum on biological and chemical security issues. The latest version of the World Health Organisation notes that laboratory biosecurity entails awareness of dual-use issues and the risks related to emerging life science technologies.

Guiding tip: This line could be used to discuss possible options for engaging prospective and practising scientists with biological and chemical security issues. It could also be used to discuss indicative content for biological and chemical security courses and how this could be tailored to the learning and training needs of scientists at different stages of their career.



Line 3: The meeting in the Dean's office continues.

Guiding tip: This line could be used to discuss how the webinar series could facilitate the inclusion of biological and chemical security issues in science curricula. It could also be used to discuss what additional steps could be implemented to foster long-term engagement with biological and chemical security issues among staff and students.

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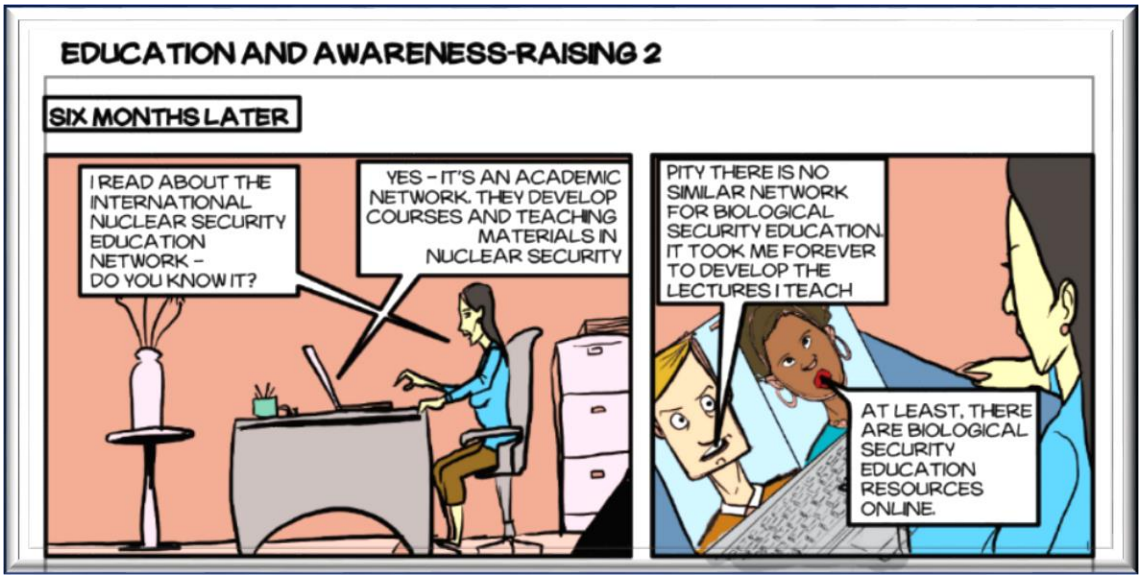
Page 2 of this cartoon shows the Chair of the Life Sciences Committee on Biological and Chemical Security Education participating in a video conference. The situation here takes place 6 months after the meeting with the Dean of the School of Life Sciences in page 1.

Page 2 - http://repository.londonmet.ac.uk/6429/.



Line 1: The Chair of the Life Sciences Committee on Biological and Chemical Security Education is on a video conference call.

Relevance to the suggested topic for discussion: Established in 2010, the International Nuclear Security Education Network (INSEN) is a partnership between academic institutions around the world and the International Atomic Energy Agency (IAEA) which seeks to promote sustainable nuclear security education. INSEN facilitates the development of teaching and training resources; faculty development; student exchange programmes; and the implementation of (joint) degree programmes in nuclear security.

Guiding tip: This line could be used to discuss the role of academic and professional networks, partnerships, and consortia in developing and implementing biological and chemical security curricula. It could be used to discuss options for enhancing data sharing and cooperation on promoting biological and chemical security education and training.

Line 2: The video call continues.

Relevance to the suggested topic for discussion: The OIE Guidelines for Responsible Conduct in Veterinary Research note that the risk assessment and management of dual-use life sciences research is a continuous process from the inception of a research project until its completion and dissemination of results.

Guiding tip: This line could be used to discuss guidelines and framework documents on biological and chemical security risk assessment. It could also be used to discuss how biological and chemical security risk assessment differs from biosafety and chemical safety risk assessment.

Line 3: The video call continues.

Relevance to the suggested topic for discussion: A well-documented example of dual-use life science research is the creation of an airborne H5N1 avian influenza virus. The Multiple Uses of Chemistry exercise is an example of an active learning exercise that examines the security and ethics of multi-use chemicals.

Guiding tip: This line could be used to discuss examples of dual-use research and how chemical and security risks could be managed. It could be used to discuss strategies, procedures, and tools that could facilitate the identification and mitigation of chemical and biological security risks in research.

Indicative topic for discussion #4: Possible strategies for dual-use risk management in science research

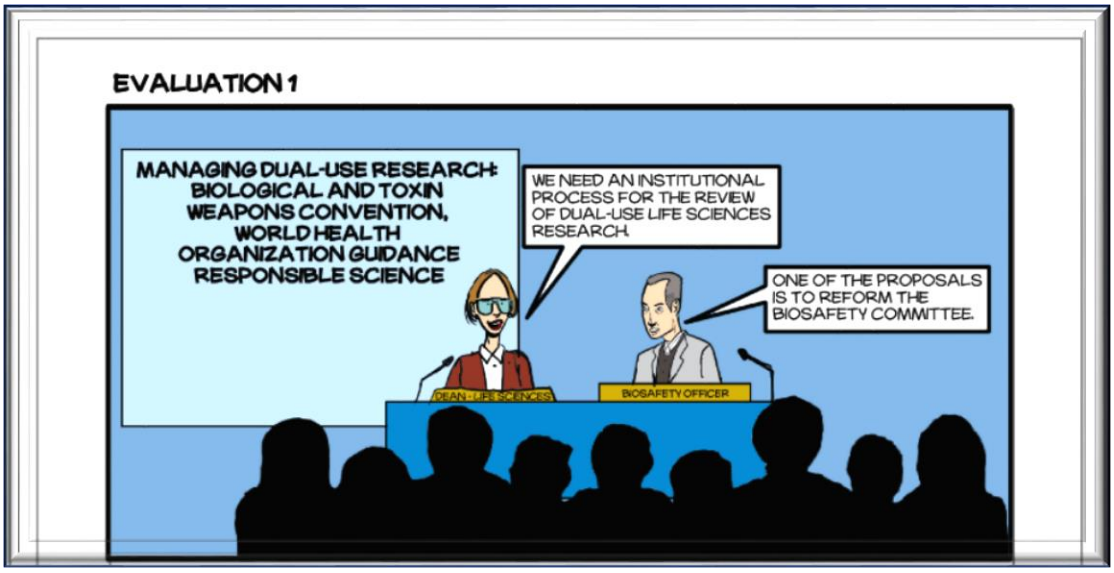
Introduction

Cartoon #4, Evaluation could be used to discuss indicative strategies for dual-use risk management in science research.

Step-by-step topic mapping

Page 1 of this cartoon shows a staff consultation meeting that is chaired by the Dean of the School of Life Sciences (Cartoons #2 and #3) and the institutional Biosafety Officer.

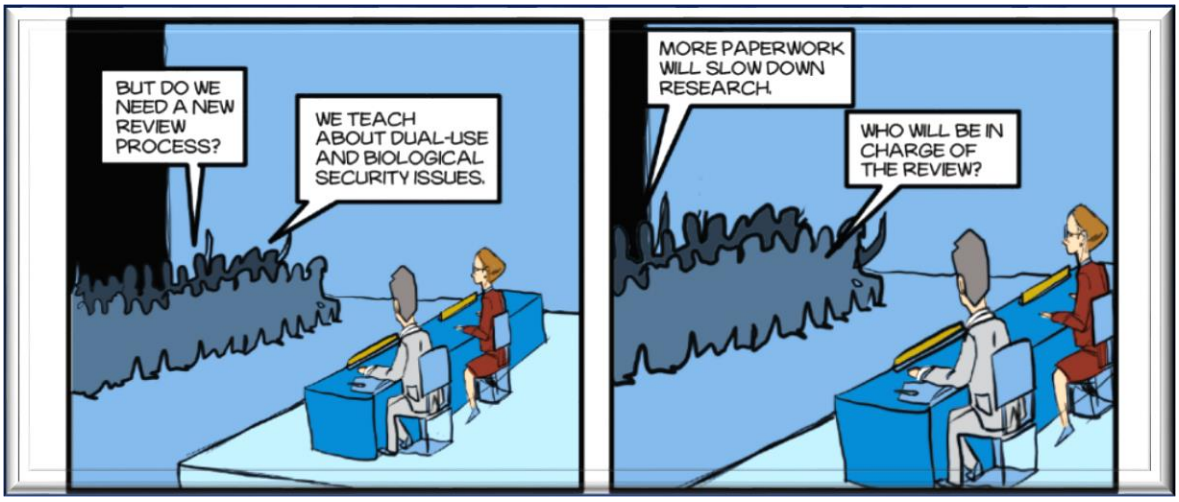
Page 1 – http://repository.londonmet.ac.uk/6430/.



Line 1: The Dean of the School of Life Sciences and the institutional Biosafety Officer chair a consultation meeting.

Relevance to the suggested topic for discussion: Both the Biological and Toxin Weapons Convention (BTWC) and the Chemical Weapons Convention (CWC) use the general purpose criterion to define biological and chemical weapons. Taken together, the Conventions aim to ensure that biological agents, toxins, and toxic chemicals are used only for peaceful purposes. Biosecurity risk assessment is a foundational element of a biosafety programme and the World Health Organisation (WHO) has recommended regular and comprehensive assessment of the dual-use potential of laboratory activities that takes into account the BTWC provisions and other relevant international regulations and frameworks that address the risk of biological weapons and bioterrorism.

Guiding tip: This line could be used to discuss the pros and cons of a review process for dual-use research. It could be used to discuss existing policies, measures, and procedures for risk management in life sciences and/or chemistry.



Line 2: The consultation meeting continues.

Relevance to the suggested topic for discussion: The Biosecurity Office in the Netherlands – a national information centre and an advisory body to the government and all Dutch institutions that work high-risk pathogens, knowledge, information and technologies – has developed several indicative tools for biosecurity and dual-use risk monitoring and assessment. The Dual-Use Quickscan is an online tool that facilitates the identification of dual-use aspects in research. The Laboratory Biosecurity Assessment and Monitoring Checklist developed by Malaysian and Dutch experts is an information-gathering tool for external assessments and can be used to strengthen biosecurity management programmes within organisations.

The United States Government Policy for Oversight of Life Sciences Dual-Use Research of Concern (DURC) introduces an additional review process of federally funded research involving seven classes of experiments with listed biological agents and toxins. The review process includes a risk assessment which is used to develop a risk mitigation plan. The United States Government Policy for Institutional Oversight of Life Sciences Dual-Use Research of Concern seeks to strengthen ongoing institutional review of certain life sciences research with high-consequence pathogens and toxins in order to identify potential DURC and mitigate risks where appropriate.

Guiding tip: This line could be used to discuss the scope and purpose of a dual-use risk review process (e.g. criteria that could be used, applicability). It could also be used to discuss the extent to which a dual-use review process could be incorporated into national and / or institutional biosafety and biosecurity risk management procedures and practices.

Line 3: The Biosafety Officer and the Dean of the School of Life Sciences summarise the outcomes of the consultation meeting.

Guiding tip: This line could be used to discuss the process of developing a policy for dual-use review (e.g. who could be involved, what mechanisms could be used to promote participation and dialogue, what steps could be used to address needs and concerns, what practical considerations and challenges may need to be addressed, etc.). It could also be used to discuss and compare different strategies and indicative tools for the review of dual-use research.

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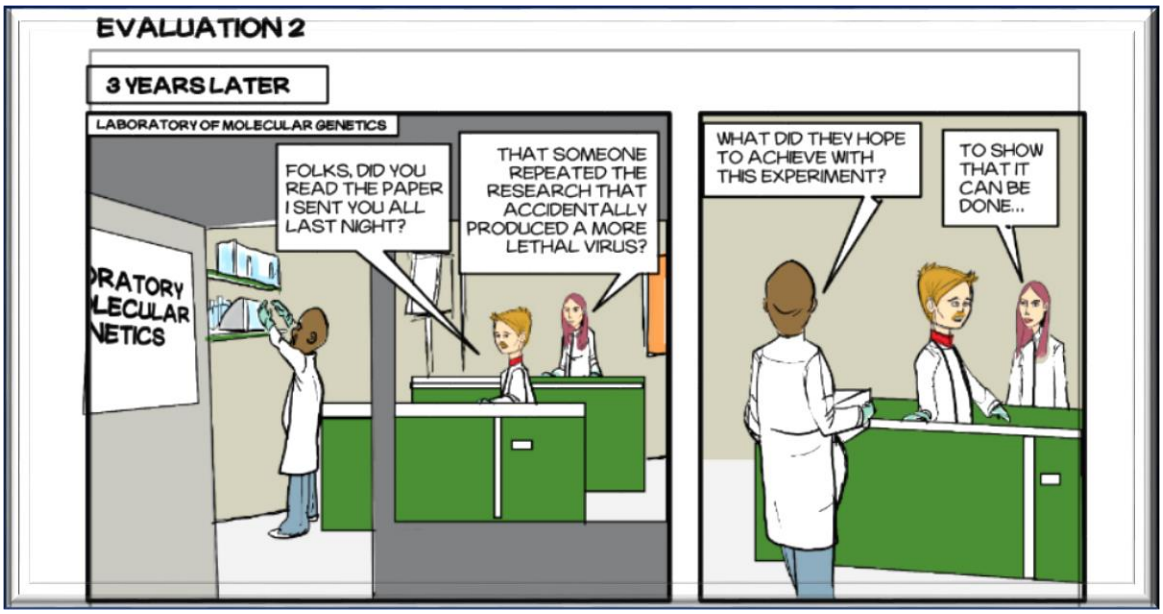
Page 2 of this cartoon shows a situation that takes place in the laboratory of molecular genetics at the same institution three years after the consultation meeting described on page 1.

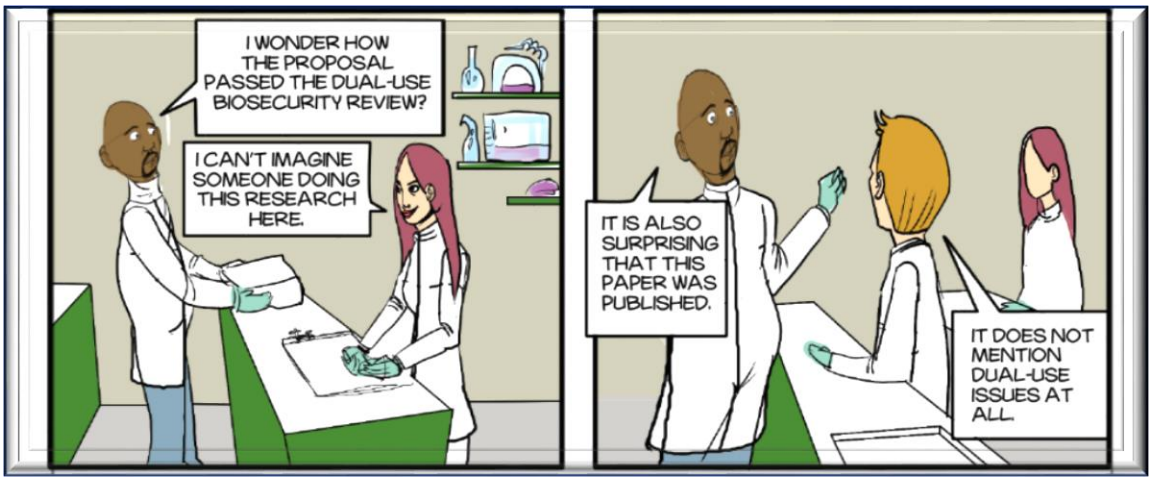
Page 2 – http://repository.londonmet.ac.uk/6431/.



Line 1: Three scientists are having a conversation.

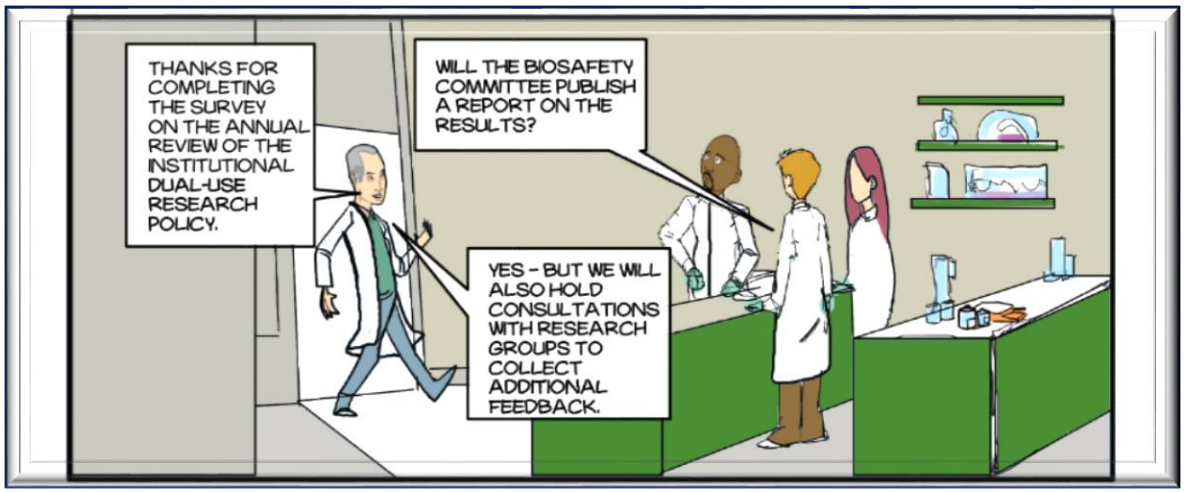
Relevance to the suggested topic for discussion: In 2001, a team of scientists accidentally discovered a method for increasing the virulence of the virus that causes mousepox. Mousepox does not infect humans but is related to the *variola* virus which causes small pox in humans, a highly contagious and deadly disease that was officially eradicated in the yearly 1980s. After the study was published, another researchers' team used the results to create a vaccine-resistant strain of the mousepox virus. Another controversial experiment that has attracted considerable attention concerns the artificial synthesis of the horsepox virus which is extinct.

Guiding tip: This line could be used to discuss how the risks and benefits of dual-use research could be assessed and balanced. It could also be used to discuss the role of formal procedures for identifying, communicating, and managing dual-use risks.



Line 2: The conversation among the three scientists continues.

Guiding tip: This line could be used to discuss to what extent awareness and education of biological and chemical security could contribute to the management of dual-use risks. It could be used to discuss what skills and knowledge could enable scientists to be prepared to recognise and address dual-use risks in their practice.



Line 3: The Biosafety Officer who was co-chairing the consultation meeting (page 1) enters the laboratory.

Story background: The *Culture of Biosafety, Biosecurity, and Responsible Conduct in the Life Sciences – (Self-) Assessment Framework* describes organisational culture in terms of four elements: (1) management systems; (2) behaviour of leadership and personnel; (3) principles for guiding decisions and behaviour; and (4) beliefs, opinions, and attitudes. The Framework could be used to identify institutional strengths and needs for the in-depth implementation of an integrated approach to biological risk management.

Guiding tip: This line could be used to discuss possible steps and measures for strengthening institutional culture for sustainable biological risk management.

Indicative topic for discussion #5: Role of dual-use risk management in strengthening 'one health' security

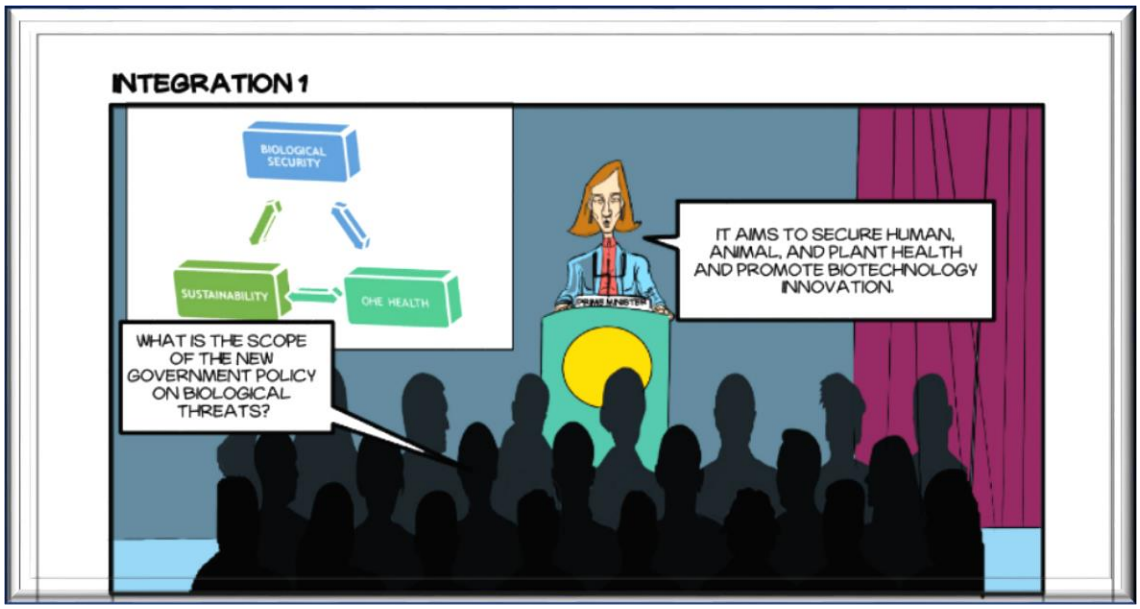
Introduction

Cartoon #5, Integration could be used to discuss the role of dual-use risk management in strengthening 'one health' security. One Health refers to the inter-dependence of human, animal, and plant health. Threats to 'one health' security include natural disease outbreaks, accidental release of pathogens, toxins, and toxic chemicals, and deliberate misuse of biological agents, toxins, or toxic chemicals.

Step-by-step topic mapping

Page 1 of this cartoon shows two related situations. The first two lines show a press conference featuring a senior government official (e.g. Prime Minister). The third line shows a conversation involving the Dean of the School of Life Sciences (Cartoons #2, 3, and 4), the institutional Biosafety Officer (Cartoon #4), and the university Vice-Chancellor while they are watching the press conference.

Page 1 – http://repository.londonmet.ac.uk/6432/.

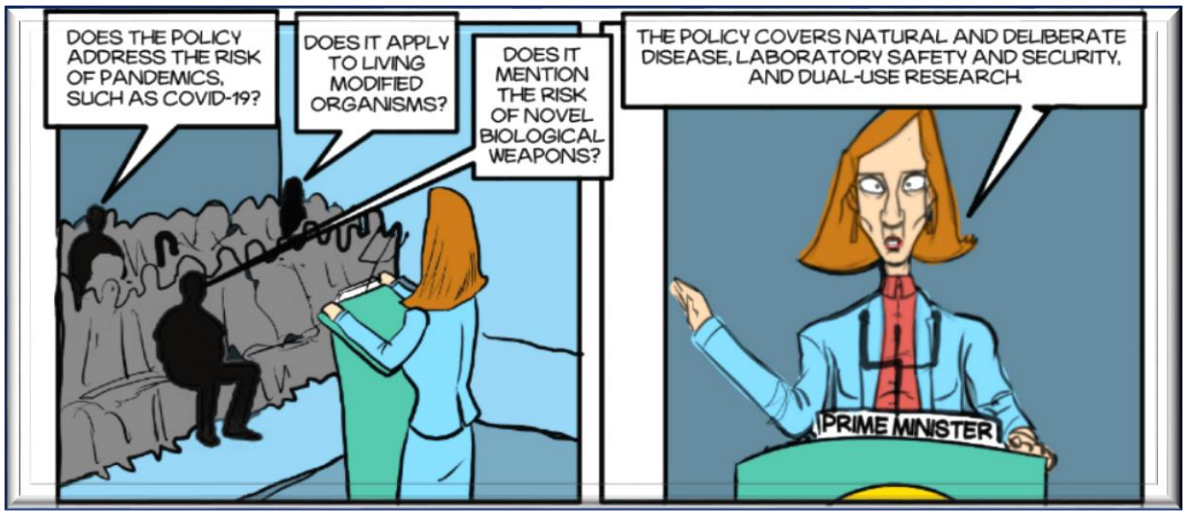


Line 1: A senior government official (e.g. Prime Minister) is speaking at a press conference.

Relevance to the suggested topic for discussion: A One Health approach is critical for achieving the Sustainable Development Goals (SDGs). WHO, the World Organisation for Animal Health (OIE), and the Food and Agriculture Organisation of the United Nations (UN FAO) work together to strengthen disease prevention and response, particularly as regards zoonotic and neglected, emerging, and re-emerging diseases, and promote a multi-sectoral approach for food safety and security.

Under the 2005 International Health Regulations of the World Health Organisation (WHO), States Parties are obliged to develop and maintain minimum core capacities for surveillance and response to any potential public health events of international concern. These capacities include legislation and financing; IHR coordination; zoonotic events and the human-animal interface; food safety; laboratory; surveillance; human resources; national emergency framework; health service provision; risk communication; points of entry; chemical events; and radiation emergencies.

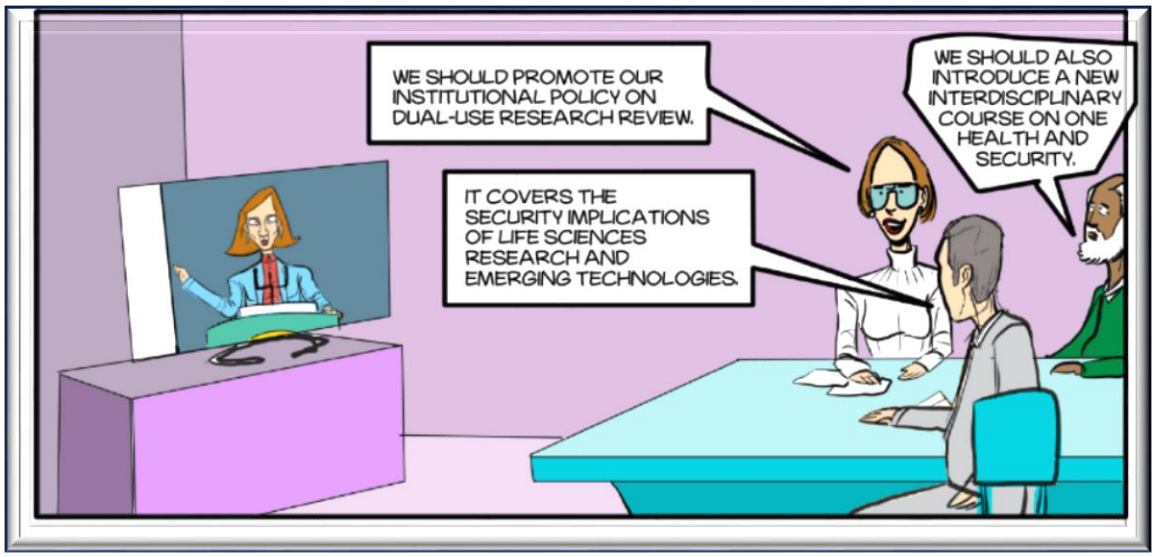
Guiding tip: This line could be used to discuss the elements of an effective One Health approach. It could also be used to discuss the implications of a One Health approach for research in life sciences and chemistry.



Line 2: The press conference continues.

Relevance to the suggested topic for discussion: The World Health Organisation (WHO) has recommended that considerations for deliberate releases of biological agents, toxins, or toxic chemicals should be incorporated into existing public health infrastructures, rather than developing separate infrastructures. The World Organisation for Animal Health (OIE) notes that "the response to disease is the same whether it is directed against natural infection, or deliberate or accidental release. In the case of zoonotic diseases, coordination of the animal health and public health response is essential, and control is often best focused on eliminating or controlling the pathogen at the animal source. When there is suspicion of malicious release, collaboration with law enforcement agencies becomes an important part of the response."

Guiding tip: This line could be used to discuss how research in life sciences and chemistry could support prevention and response to health emergencies regardless of their origins. It could also be used to discuss how sustainable partnerships between science and security sectors could be fostered to promote effective cooperation.



Line 3: The Dean of the School of Life Sciences (Cartoon #2, 3, and 4), Biosafety Officer (Cartoon #4), and the university Vice-Chancellor are watching the press conference on the television.

Guiding tip: This line could be used to discuss how dual-use risk assessment strategies and measures could help protect human, animal, and plant health. It could also be used to discuss whether and how awareness of the risk of deliberate disease could contribute to preparedness and response to biological threats regardless of their origins.

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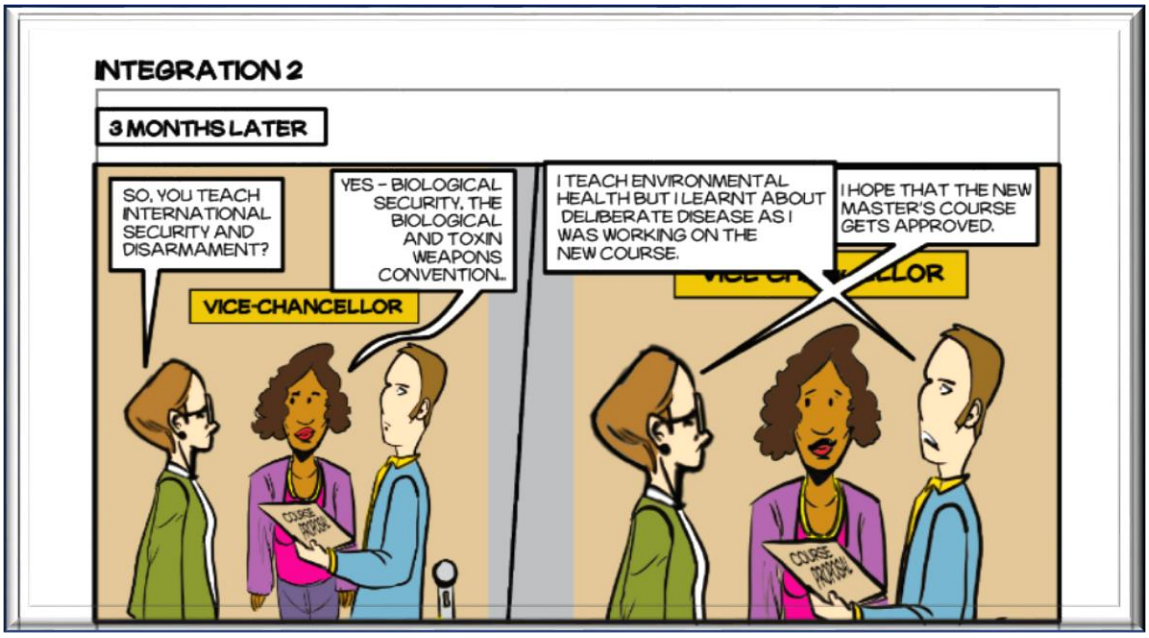
Page 2 of this cartoon shows a situation that takes place three months after the press conference on the previous page. The Dean of the School of Life Sciences and two other academics are meeting the university Vice-Chancellor.

Page 2 - http://repository.londonmet.ac.uk/6433/.



Line 1: The Dean of the School of Life Sciences and two university lecturers are talking.

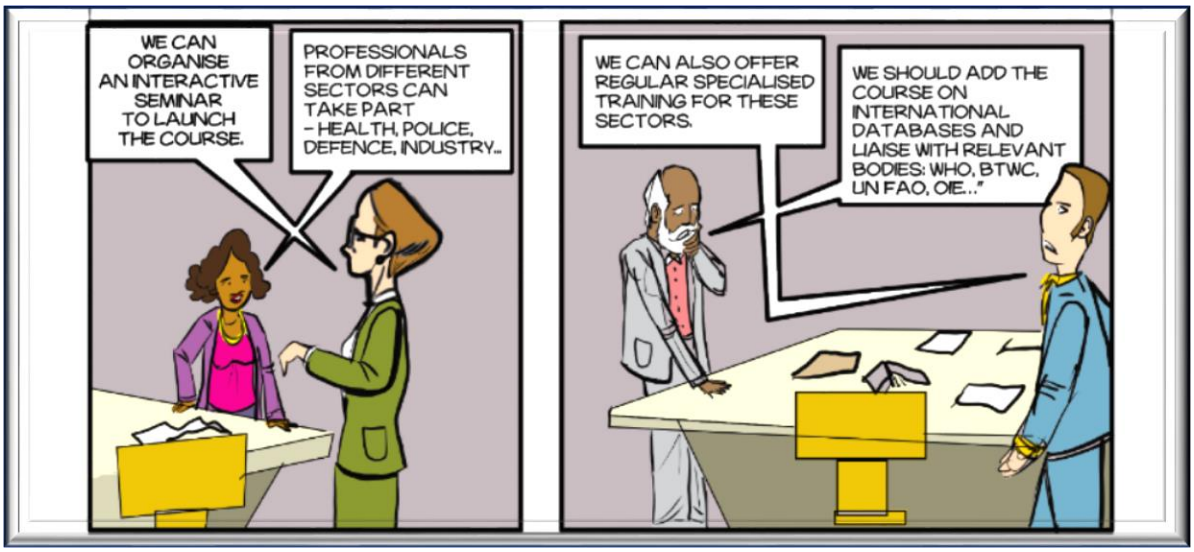
Relevance to the suggested topic for discussion: Strengthening preparedness and response to bioterrorism and agro-bioterrorism requires cross-sectoral cooperation between law enforcement, veterinary, public health, and civil protection services for early identification and investigation of suspicious biological events. The Guidelines for Investigation of Suspicious Biological Events of the World Organisation for Animal Health (OIE) provide a compilation of issues with relevance to the planning for the response to suspicious disease events. The Guidelines address the role of partnerships among different stakeholders and provide a set of indicative epidemiological, laboratory, and law enforcement indicators for assessing suspicious biological threat events.

Guiding tip: This line could be used to discuss the challenges in carrying out biological investigations and establishing the origins of a disease outbreak. It could also be used to discuss relevant international and national frameworks and mechanisms.

Line 2: The three academics are attending a meeting in office of the university Vice-Chancellor.

Relevance to the suggested topic for discussion: The OIE Guidelines for Simulation Exercises promote a multi-sectoral and interdisciplinary One Health approach to improve preparedness for zoonotic diseases and other shared threats at the human – animal – environment interface. They could be used to bring together different stakeholders with responsibilities for managing biological threats.

Guiding tip: This line could be used to discuss examples of training exercises for preparedness and response to biological threats. It could also be used to discuss good training practices and lessons learned.



Line 3: The meeting in the office of the Vice-Chancellor continues.

Guiding tip: This line could be used to discuss possible strategies for publicising and sharing training resources and materials on One Health security. It could also be used to discuss the pros and cons of integrated training programmes for countering biological threats.

ANNEX A

Cartoon series: *Strengthening the Web of Prevention against Chemical and Biological Weapons*, available via the London Metropolitan University Repository.

Cartoon folder cover – http://repository.londonmet.ac.uk/6435/.

Cartoon 1: Preventing biological weapons

Page 1 – http://repository.londonmet.ac.uk/6332/.

Page 2 – http://repository.londonmet.ac.uk/6333/.

Cartoon 2: Codes of conduct

Page 1 – http://repository.londonmet.ac.uk/6399/.

Page 2 – http://repository.londonmet.ac.uk/6400/.

Cartoon 3: Education and awareness-raising

Page 1 - http://repository.londonmet.ac.uk/6428/.

Page 2 - http://repository.londonmet.ac.uk/6429/.

Cartoon 4: Evaluation

Page 1 – http://repository.londonmet.ac.uk/6430/.

Page 2 – http://repository.londonmet.ac.uk/6431/.

Cartoon 5: Integration

Page 1 – http://repository.londonmet.ac.uk/6432/.

Page 2 - http://repository.londonmet.ac.uk/6433/.

Cartoon folder back cover – http://repository.londonmet.ac.uk/6434/.