

Biological Security Education Handbook: The Power of Team-Based Learning

APPENDIX B

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GUIDELINES ON COURSE-DEVELOPMENT

The following section is designed to provide instructors, lecturers, and practitioners with guiding information on how individual chapters of the Guide and the Handbook can be combined for the purposes of developing tailored courses and lecture series. Having a single integrated course/module on biological security taught over a whole semester allows the books to be used in their entirety. However, since not many departments and faculties at present offer such courses/modules, or have the curriculum time and space required for their introduction, starting ‘small’ with a short lecture/seminar series, or a ‘crash’ train-the-trainer specialised course may be deemed an appealing option. To this end, the guidelines below are intended to offer useful tips and practical information on selecting and combining individual chapters, based on the target audience that you are planning to reach out to, and the objectives that you are trying to achieve.

The guidelines are not prescriptive; they are indicative. They have been developed as a result of hundreds of hours of interaction with life science faculty members, students, and practitioners in different settings and in various parts of the world. The chief underlying assumption is that the majority of learners or course/seminar participants would, by and large, have limited prior engagement with biological security. They may have been exposed to biological security issues through the media, or through attending a relevant conference/workshop, or through informal communication with their peers/colleagues. Nonetheless, few of them are expected to have come across such issues as part of formal education and professional instruction.

Table A.1.2 provides a summary of suggested chapter combinations for different target audiences. Detailed guidelines and additional tips for each suggested combination are provided below.

Table A.1.2: Suggested Chapter Combinations

Target Audience	Purpose	Level	Core Chapters of the Guide	Additional/Optional Chapters
Undergraduate Students	Seminar/Lecture Series	Introduction	<ul style="list-style-type: none">➤ Chapter 2/8*➤ Chapter 6➤ Chapters 7/18	<ul style="list-style-type: none">➤ Chapters 3/4/5➤ Chapters 9/10/11

Postgraduate/ Master-Level Students	Seminar/Lecture Series	Introduction	<ul style="list-style-type: none"> ➤ Chapters 2/8 ➤ Chapters 3/4/5 ➤ Chapter 6 ➤ Chapters 7/18 	<ul style="list-style-type: none"> ➤ Chapters 9/10/11 ➤ Chapters 12/13
PhD Students (i)	Seminar/Lecture Series	Introduction	<ul style="list-style-type: none"> ➤ Chapters 2/8 ➤ Chapters 7/18 ➤ Chapters 12/13 ➤ Chapters 14/15/16/17 	<ul style="list-style-type: none"> ➤ Chapters 3/4/5 ➤ Chapter 6 ➤ Chapters 9/10/11
PhD Students (ii)	Short Course: one day	Introduction	<ul style="list-style-type: none"> ➤ Chapters 2/8 ➤ Chapters 7/18 ➤ Chapters 12/13 ➤ Chapters 14/15/16/17 	<ul style="list-style-type: none"> ➤ Chapters 3/4/5 ➤ Chapter 6 ➤ Chapters 9/10/11
Continued Professional Development: General	Short Course: one day	Introduction	<ul style="list-style-type: none"> ➤ Chapters 3/4/5 ➤ Chapters 7/18 ➤ Chapters 12/13 ➤ Chapters 14/15/16/17 	<ul style="list-style-type: none"> ➤ Chapters 2/8 ➤ Chapter 6 ➤ Chapters 9/10/11

* Where more than one chapter is listed, it is up to the instructor to choose which chapter to use for the purposes of their course.

Undergraduate-Level Seminar/Lecture Series

Some life science faculties/departments tend to offer courses in bioethics or responsible conduct of research for undergraduate students. Such courses may be used as an entry point for introducing life science undergraduates to biological security, as part of a broader responsible science framework. A short lecture/seminar series, covering issues of biological security can enhance students' understanding of the multifaceted social, ethical, legal, and security concerns arising from novel biotechnology advances.

The **core chapters** recommended for such types of lecture/seminar series include:

- A choice between **Chapter 2**, *Social, Ethical, and Legal Responsibilities of Life Scientists* (Guide equivalent: Chapter 2, *Biosecurity Challenges in the 21st Century: The Case of Gain-of-Function Experiments*) and **Chapter 8**, *Dual Use and Responsible Conduct of Science* (Guide equivalent: Chapter 8, *Dual Use and the Progress of the Life Sciences: A Case for Promoting Biosecurity and the Responsible Conduct of Research*).

- **Chapter 6**, *The Biological and Toxin Weapons Convention and the Role of Life Scientists* (Guide equivalent: Chapter 6, *The Biological and Toxin Weapons Convention: Structure and Development*).
- A choice between **Chapter 7**, *The Web of Prevention* (Guide equivalent: Chapter 7, *The Idea of a Web of Prevention*) and **Chapter 18**, *The Role of the Scientific Community in the Development and Strengthening of International Biosecurity Regulations* (Guide equivalent: Chapter 18, *The Future Governance of Biotechnology*).

Those particular chapters were selected, as they introduce students to the following core concepts:

- Dual use and broader biological security
- Novel scientific advances that pose social, ethical, legal, and security concerns
- The Biological and Toxin Weapons Convention (BTWC) and its general purpose criterion
- The broader international regulatory framework of relevance to biological security
- The web of prevention

If time and space in the curriculum permit, the following **additional chapters** can also be used:

- A choice between **Chapter 3**, *Advances in Science and Technology, and the Biological and Toxin and Chemical Weapons Conventions* (Guide equivalent: Chapter 3, *Advances in Science and Technology and the Evolution of Bioweapons Capability*), or **Chapter 4**, *Examining the Risk of Bioterrorism* (Guide equivalent: Chapter 4, *Biological Weapons as Weapons of Terror: Perspectives on the Threat*), or **Chapter 5**, *Biosecurity in the Context of Natural Disease Outbreaks* (Guide equivalent: Chapter 5, *Natural Outbreaks and Biosecurity: The 2014 Ebola Outbreak*).
- A choice between **Chapter 9**, *Convergence of Chemistry and Biology, Security Risks, and the Role of Industry* (Guide equivalent: Chapter 9, *The Role of Industry in Promoting Biosecurity: A Case Study of the Convergence of Chemistry and Biology*), or **Chapter 10**, *International and National Scientific Organisations, and Biological Security* (Guide equivalent: Chapter 10, *10. The Role of Scientific Organisations in Promoting Biosecurity: A Case Study on IAP*), or **Chapter 11**, *Review of Scientific and Technological Developments and the Biological and Toxin Weapons Convention* (Guide equivalent: Chapter 11, *Review of Science and Technology: A Case Study on the Biological and Toxin Weapons Convention Implementation Support Unit*).

Selecting one chapter from each of the two groups will help learners develop a better and deeper understanding of biological security. The chapters in the first category will broaden their appreciation of the possible risks and threats; the chapters in the second category will give them insights into the range of stakeholders involved in promoting biological security.

Postgraduate-Level Seminar/Lecture Series

The format for introducing postgraduate life science students to biological security is similar to the one suggested for undergraduate courses. Once again, programmes in bioethics and responsible conduct of research typically exist, and can be used as platforms for promoting biological security competence. It is recommended that the topics and key concepts at this level are similar to the ones suggested for undergraduate students. However, it is also recommended that the core material delivered to postgraduate students is broader than what is suggested at undergraduate level. In particular, the potential risks arising from novel life science advances can be explored in greater depth, and if time permits, the discussion of stakeholders involved in promoting biological security can be extended to cover the role of the law enforcement community.

The following **core chapters** are suggested:

- A choice between **Chapter 2**, *Social, Ethical, and Legal Responsibilities of Life Scientists* (Guide equivalent: Chapter 2, *Biosecurity Challenges in the 21st Century: The Case of Gain-of-Function Experiments*) and **Chapter 8**, *Dual Use and Responsible Conduct of Science* (Guide equivalent: Chapter 8, *Dual Use and the Progress of the Life Sciences: A Case for Promoting Biosecurity and the Responsible Conduct of Research*).
- A choice between **Chapter 3**, *Advances in Science and Technology, and the Biological and Toxin and Chemical Weapons Conventions* (Guide equivalent: Chapter 3, *Advances in Science and Technology and the Evolution of Bioweapons Capability*), or **Chapter 4**, *Examining the Risk of Bioterrorism* (Guide equivalent: Chapter 4, *Biological Weapons as Weapons of Terror: Perspectives on the Threat*), or **Chapter 5**, *Biosecurity in the Context of Natural Disease Outbreaks* (Guide equivalent: Chapter 5, *Natural Outbreaks and Biosecurity: The 2014 Ebola Outbreak*).
- **Chapter 6**, *The Biological and Toxin Weapons Convention and the Role of Life Scientists* (Guide equivalent: Chapter 6, *The Biological and Toxin Weapons Convention: Structure and Development*).
- A choice between **Chapter 7**, *The Web of Prevention* (Guide equivalent: Chapter 7, *The Idea of a Web of Prevention*) and **Chapter 18**, *The Role of the Scientific Community in the Development and Strengthening of International Biosecurity Regulations* (Guide equivalent: Chapter 18, *The Future Governance of Biotechnology*).

Among the **additional chapters** suggested for this type of lecture/seminar series are:

- A choice between **Chapter 9**, *Convergence of Chemistry and Biology, Security Risks, and the Role of Industry* (Guide equivalent: Chapter 9, *The Role of Industry in*

Promoting Biosecurity: A Case Study of the Convergence of Chemistry and Biology), or **Chapter 10**, *International and National Scientific Organisations, and Biological Security* (Guide equivalent: Chapter 10, *10. The Role of Scientific Organisations in Promoting Biosecurity: A Case Study on IAP*), or **Chapter 11**, *Review of Scientific and Technological Developments and the Biological and Toxin Weapons Convention* (Guide equivalent: Chapter 11, *Review of Science and Technology: A Case Study on the Biological and Toxin Weapons Convention Implementation Support Unit*).

- A choice between **Chapter 12**, *Building Sustainable Partnerships between the Scientific and Law Enforcement Communities* (Guide equivalent: Chapter 12, *The Federal Bureau of Investigation Biosecurity Program: A Case Study of Law Enforcement and Outreach*) and **Chapter 13**, *Interagency Communication and Biological Security* (Guide equivalent: Chapter 13, *Multisectoral Coordination for Biosecurity Preparedness: A Case Study on INTERPOL*).

PhD Students (i): Seminar/Lecture Series

The structure of PhD programmes tends to vary among countries and institutions, so, in order to provide instructors with a greater degree of flexibility, outlines for both a seminar/lecture series and a short course (see below) are suggested.

It is expected that at this educational stage, students/researchers will already have more advanced experience in working in a laboratory setting, in comparison to their undergraduate and master-level counterparts. For this reason, it is suggested that the focus of the biological security education programmes is on developing an understanding of the measures for prevention and response. Whilst discussion of the potential risks is also strongly encouraged, sensitising researchers to the relevant policies and mechanisms for addressing and dealing with biological security risks is suggested as the area on which the primary learning emphasis should be laid.

The recommended core concepts to be conveyed as part of a seminar/lecture series at this level therefore include:

- Dual use and biological security
- Risks and benefits associated with novel scientific advances
- International policies and guidelines with relevance to biological security
- Role of the law enforcement community in promoting biological security
- National policies and regulatory frameworks with relevant to biological security

The suggested **core chapters** feature:

- A choice between **Chapter 2**, *Social, Ethical, and Legal Responsibilities of Life Scientists* (Guide equivalent: Chapter 2, *Biosecurity Challenges in the 21st Century: The Case of Gain-of-Function Experiments*) and **Chapter 8**, *Dual Use and Responsible Conduct of Science* (Guide equivalent: Chapter 8, *Dual Use and the*

Progress of the Life Sciences: A Case for Promoting Biosecurity and the Responsible Conduct of Research).

- A choice between **Chapter 7**, *The Web of Prevention* (Guide equivalent: Chapter 7, *The Idea of a Web of Prevention*) and **Chapter 18**, *The Role of the Scientific Community in the Development and Strengthening of International Biosecurity Regulations* (Guide equivalent: Chapter 18, *The Future Governance of Biotechnology*).
- A choice between **Chapter 12**, *Building Sustainable Partnerships between the Scientific and Law Enforcement Communities* (Guide equivalent: Chapter 12, *The Federal Bureau of Investigation Biosecurity Program: A Case Study of Law Enforcement and Outreach*) and **Chapter 13**, *Interagency Communication and Biological Security* (Guide equivalent: Chapter 13, *Multisectoral Coordination for Biosecurity Preparedness: A Case Study on INTERPOL*).
- A choice between **Chapter 14**, *National Implementation of Biosecurity: A Case Study of Denmark* (Guide equivalent: Chapter 14, *The Danish Biosecurity System*), or **Chapter 15**, *Sustainable Implementation of Biosecurity through National, Regional, and International Partnerships in Jordan* (Guide equivalent: Chapter 15, *Fostering Biosecurity in Jordan*), or **Chapter 16**, *National Implementation of Biosecurity and the Role of Scientists (1): A Case Study of South Africa* (Guide equivalent: Chapter 16, *National Implementation of Biosecurity in South Africa*), or **Chapter 17**, *National Implementation of Biosecurity and the Role of Scientists (1): A Case Study of Canada* (Guide equivalent: Chapter 17, *National Implementation of Biosecurity in Canada*).

If time permits, and in order to encourage consideration of, and deliberation on, the security concerns arising from the life sciences, the BTWC regime, and the range of stakeholders engaged in biological security, the following **additional chapters** are suggested:

- A choice between **Chapter 3**, *Advances in Science and Technology, and the Biological and Toxin and Chemical Weapons Conventions* (Guide equivalent: Chapter 3, *Advances in Science and Technology and the Evolution of Bioweapons Capability*), or **Chapter 4**, *Examining the Risk of Bioterrorism* (Guide equivalent: Chapter 4, *Biological Weapons as Weapons of Terror: Perspectives on the Threat*), or **Chapter 5**, *Biosecurity in the Context of Natural Disease Outbreaks* (Guide equivalent: Chapter 5, *Natural Outbreaks and Biosecurity: The 2014 Ebola Outbreak*).
- **Chapter 6**, *The Biological and Toxin Weapons Convention and the Role of Life Scientists* (Guide equivalent: Chapter 6, *The Biological and Toxin Weapons Convention: Structure and Development*).

- A choice between **Chapter 9**, *Convergence of Chemistry and Biology, Security Risks, and the Role of Industry* (Guide equivalent: Chapter 9, *The Role of Industry in Promoting Biosecurity: A Case Study of the Convergence of Chemistry and Biology*), or **Chapter 10**, *International and National Scientific Organisations, and Biological Security* (Guide equivalent: Chapter 10, *10. The Role of Scientific Organisations in Promoting Biosecurity: A Case Study on IAP*), or **Chapter 11**, *Review of Scientific and Technological Developments and the Biological and Toxin Weapons Convention* (Guide equivalent: Chapter 11, *Review of Science and Technology: A Case Study on the Biological and Toxin Weapons Convention Implementation Support Unit*).

PhD Students (ii): One-Day Short Course

The suggested outline for the short training course for PhD students/researchers is identical to the **core chapters** recommended for a lecture/seminar series. If time permits, it is possible to spread the suggested training content over several days, in order to allow for an in-depth discussion of the relevant concepts and issues. If time constraints are an issue, it is possible to divide the one-day training into two parts, and deliver it as two half-day courses at the start and end of a semester, or in two different semesters.

Continued Professional Development

The content of training programmes for continued professional development would entirely depend on the intended target audience. Are you trying to reach out to biosafety professionals, life science practitioners and laboratory staff, specialists in the public health sector, or faculty members at universities and institutes? Each of those groups will have different learning needs and requirements. Whilst finding the middle ground can appear challenging, it is important to remember that training programmes, especially for adult learners, evolve through trial and error. Always listen to what participants have to say and feed in during and at the end of the training course – this will help you not only to improve the quality of the course next time round but also to make adjustments in real time and on the spot. Try to establish from the outset what the learning needs and expectations of the course participants are and strive to tailor your course in a way that would allow you to meet them to the greatest extent possible. Be creative and have back-up options prepared, and if necessary, improvise! Every effort that you make to accommodate participants' needs and requirements would be met positively and be greatly appreciated.

The outline that is suggested in Table A.1.2 is a generic one. It is intended to serve as a useful starting point in developing training programmes. It is balanced, insofar as it provides an overview of a range of topics featuring possible biological security risks, relevant international and national policies and regulatory frameworks, and the role of the law enforcement community. The choice of specific chapters will be largely informed by the type of practitioners to whom you are aiming to reach out. For the purposes of the generic course, the following chapters are suggested:

- A choice between **Chapter 3**, *Advances in Science and Technology, and the Biological and Toxin and Chemical Weapons Conventions* (Guide equivalent: Chapter 3, *Advances in Science and Technology and the Evolution of Bioweapons Capability*), or **Chapter 4**, *Examining the Risk of Bioterrorism* (Guide equivalent: Chapter 4, *Biological Weapons as Weapons of Terror: Perspectives on the Threat*), or **Chapter 5**, *Biosecurity in the Context of Natural Disease Outbreaks* (Guide equivalent: Chapter 5, *Natural Outbreaks and Biosecurity: The 2014 Ebola Outbreak*).
- A choice between **Chapter 7**, *The Web of Prevention* (Guide equivalent: Chapter 7, *The Idea of a Web of Prevention*) and **Chapter 18**, *The Role of the Scientific Community in the Development and Strengthening of International Biosecurity Regulations* (Guide equivalent: Chapter 18, *The Future Governance of Biotechnology*).
- A choice between **Chapter 12**, *Building Sustainable Partnerships between the Scientific and Law Enforcement Communities* (Guide equivalent: Chapter 12, *The Federal Bureau of Investigation Biosecurity Program: A Case Study of Law Enforcement and Outreach*) and **Chapter 13**, *Interagency Communication and Biological Security* (Guide equivalent: Chapter 13, *Multisectoral Coordination for Biosecurity Preparedness: A Case Study on INTERPOL*).
- A choice between **Chapter 14**, *National Implementation of Biosecurity: A Case Study of Denmark* (Guide equivalent: Chapter 14, *The Danish Biosecurity System*), or **Chapter 15**, *Sustainable Implementation of Biosecurity through National, Regional, and International Partnerships in Jordan* (Guide equivalent: Chapter 15, *Fostering Biosecurity in Jordan*), or **Chapter 16**, *National Implementation of Biosecurity and the Role of Scientists (1): A Case Study of South Africa* (Guide equivalent: Chapter 16, *National Implementation of Biosecurity in South Africa*), or **Chapter 17**, *National Implementation of Biosecurity and the Role of Scientists (1): A Case Study of Canada* (Guide equivalent: Chapter 17, *National Implementation of Biosecurity in Canada*).

If, for example, the goal is to reach out to faculty members, it might be worth including **Chapter 8**, *Dual Use and Responsible Conduct of Science* (Guide equivalent: Chapter 8, *Dual Use and the Progress of the Life Sciences: A Case for Promoting Biosecurity and the Responsible Conduct of Research*) and **Chapter 10** *International and National Scientific Organisations, and Biological Security* (Guide equivalent: Chapter 10, *The Role of Scientific Organisations in Promoting Biosecurity: A Case Study on IAP*), as both of them look into biological security education initiatives.