

Challenges and Opportunities for Education About Dual Use Issues in the Life Sciences

This report offers insights on education about dual use issues, concerns stemming from the fact that advances in the life sciences could yield knowledge, tools, and techniques useful for biological weapons or bioterrorism. Focusing on the role of education in forming the foundation for a broad response to these potential risks, the report identifies: (1) the extent to which dual use issues are currently included in postsecondary education in the life sciences, (2) the contexts in which education is occurring, and (3) what needs exist that must be addressed to enable a significant expansion of education about dual use issues.

In recent years, concerns have grown that advances in the life sciences, while offering great current and potential benefits, will yield knowledge, tools, and techniques that could be misused for biological weapons or bioterrorism. Considerable work has been carried out by various international organizations to investigate these “dual use” issues in the life sciences, and has highlighted the need to educate the science community more effectively about its roles and responsibilities in helping reduce the risk that science will be misused.

To build on that body of work, the U.S. Department of State asked IAP: The Global Network of Science Academies¹ to organize a workshop to discuss ways to educate life scientists on dual use issues. IAP carried out the

task through its Biosecurity Working Group, which was created in 2004 and currently includes the academies of China, Cuba, Poland (chair), Nigeria, the United Kingdom and the United States.

The National Research Council of the U.S. National Academy of Sciences convened a committee of experts to help organize the workshop, and to develop a consensus report based on both insights offered at the workshop and additional data and research. Two other international science organizations, the International Union of Biochemistry and Molecular Biology, and the International Union of Microbiological Societies, served as co-conveners of the workshop. Hosted by the Polish Academy in November 2009, more than 60 participants from almost 30 countries attended the workshop, including life scientists, bioethics and biosecurity practitioners, and experts in the design and implementation of education.

Discussions at the workshop helped develop two important themes that the National Research Council committee considered while developing its consensus report. First, in order to engage the life sciences community, the security issues related to research with dual use potential would best be approached in the context of responsible conduct of research, the wider array of issues that the community addresses to fulfill its responsibilities to society. Second, education about dual use issues would benefit from the



Figure 1. A biologist working in a laboratory designed to handle pathogenic materials.

Source: NAID/NIH

¹ Formerly the Inter-Academy Panel on International Issues.

insights of the “science of learning,” the growing body of research about how individuals learn at various stages of their lives and careers and the most effective methods for teaching them.

The Baseline

Based on specially commissioned papers, other background materials, and the discussions at the workshop, the committee arrived at several findings about the current state of education. To date, there has been very limited coverage of dual use issues in education in the life sciences, either as stand-alone courses or as parts of other courses, although in recent years such education has begun to increase in many parts of the world. The increase has resulted primarily from the work of interested, committed individuals or specific projects; there are a few cases, however, of government support and encouragement. At present, most education about

dual use issues occurs as part of more general education about responsible conduct of research, in basic life sciences courses, or as part of biosafety or bioethics training. A number of online resources for education about dual use issues are available, both for use by individuals and as part of coursework or training. Essentially all of them are from the United States or the United Kingdom.

Conclusions: Gaps and Potential Remedies

Based on the workshop discussions and a survey of the relevant literature, the committee identified what is needed to expand the scope and scale of education about dual use issues, and developed options for meeting these needs.

Educational Materials and Methods

Given the diversity of fields, interests, and experiences across the life sciences, making dual use issues relevant to all students is a challenge. The committee found that tailoring educational materials to suit the needs of these different groups could help reach wider audiences. For example, educational materials should be adapted to students in different parts of the world, at different educational stages, and in different fields within the life sciences. In particular, the committee found that more materials are needed in languages other than English. This will be particularly important in undergraduate settings or when used as part of training for technical personnel.

In addition to online resources, educational CDs or DVDs are needed for areas that lack the sustained internet access or the capacity to take advantage of web-based materials. Providing widespread access to materials that could be adapted for specific contexts or applications using open access repositories or resource centers would help implement and sustain dual use education.

Online collaborations could be useful for developing educational materials relevant to different

Box 1. Web Resources

The committee identified a variety of online educational resources that currently exist in the United States and internationally to support undergraduate or postgraduate education about dual use issues. Examples include:

BioEdLinks: Resources for Biology Educators

<http://bioedlinks.com/>

Resources to support active learning pedagogies in undergraduate life science classrooms.

Biological Weapons Convention

[http://www.unog.ch/80256EE600585943/\(httpPages\)/04FBBDD6315AC720C1257180004B1B2F?OpenDocument](http://www.unog.ch/80256EE600585943/(httpPages)/04FBBDD6315AC720C1257180004B1B2F?OpenDocument)

Official website for the Biological Weapons Convention, the multilateral disarmament treaty banning the development, production, acquisition, transfer, retention, stockpiling, and use of biological and toxin weapons.

Case Studies in Dual-Use Biological Research, Federation of American Scientists

<http://www.fas.org/biosecurity/education/dualuse/>

The Federation of American Scientists, an independent, nonpartisan think tank and membership organization, presents case studies designed to help define the issues associated with dual-use research.

Dual-Use Bioethics, University of Bradford

<http://www.dual-usebioethics.net/>

Resources to support learning and teaching about dual-use issues.

National Academies Biosecurity Website, coming January 2011

<http://nationalacademies.org/biosecurity>

This website will aggregate information on studies and activities at The National Academies and with its international partners.

audiences, although again, issues of access to the internet could be a limiting factor. Furthermore, it will be important to develop methods that allow the life science and educational communities to review and edit educational materials, much like an appropriately monitored Wikipedia model, to ensure the materials are accurate. The ability to share lessons learned and best practices for developing educational materials as experience increases will be another key factor for success. Finally, teaching strategies need to focus on active learning and clear learning objectives, while allowing for local adaptation and application.

Implementing Education about Dual Use Issues: Practical Considerations

Content about dual use issues could be presented in a variety of contexts. For example, education about dual use issues could be incorporated into the channels through which life scientists already receive exposure to issues of responsible conduct, like biosafety, bioethics and research ethics, and responsible conduct of research education. These channels offer the greatest opportunity to reach the largest and most diverse range of students and professionals, the committee found. Furthermore, it will be important to reach out to other disciplines that are becoming an increasingly important part of life sciences research—physical sciences, mathematics, and engineering.

Opportunities to help faculty develop the skills, abilities, and knowledge needed to teach dual use issues effectively are essential if such education is to expand successfully. There are several promising models for “train-the-trainer” programs, but the best explicitly seek to create a network among faculty to support and sustain each other and to encourage expanded implementation. As well as the specific barriers posed by a lack of awareness of and engagement in dual use issues among life scientists, there are a number of obstacles to any effort to implement new content or teaching methods that must also be addressed. These include competition for space in crowded curricula, pressures on students to focus on their research, and in some cases a general lack of support for teaching.

Broader Implementation Issues

Questions related to education about dual use issues can be considered part of the larger discus-

sions and activities that have been taking place in the international scientific community about biosecurity.

- Scientific organizations and professional associations are playing leading roles in developing international support for education about dual use issues. There are significant opportunities to build on this work to carry out more systematic and coordinated education efforts.
- To enable dual use issues to become a regular part of the curriculum across the life sciences, significant sustained funding will be required to provide resources, such as materials in multiple languages, identified in the workshop and other reports.
- Governments can play a number of roles besides providing funds to encourage the expansion of education.
- Two international organizations have potentially important roles in encouraging education about dual use issues. The World Health Organization has a particular role in biosafety, while the United Nations Educational, Scientific, and Cultural Organization could make significant contributions through its work in bioethics and general science ethics.
- In addition, the upcoming Seventh Review Conference of the Biological and Toxin Weapons Convention in 2011 will provide an obvious opportunity for member states to build on prior work and take affirmative steps in support of education about dual use issues.

The Committee’s Recommendations

Based on its findings and conclusions, the committee developed recommendations to improve education on dual use issues.

General Approach

- **An introduction to dual use issues should be part of the education of every life scientist.**
- **Except in specialized cases (particular research or policy interests), this education should be incorporated within broader coursework and training rather than via stand-alone courses.**
- **Insights from research on learning and effective teaching should inform development of materials, and approaches to teaching students and preparing faculty.**

Specific Actions

Achieving the goal of making dual use issues part of broader education will require a number of specific actions. These may be undertaken separately by different organizations, but there will be substantial benefit if there is a coordinated effort across initiatives to share successful practices and lessons learned. Reflecting the diversity of situations in which education about dual use issues will take place, the report proposes high-priority actions:

- **Develop an international open access repository of materials that can be adapted for the local context.**
 - The repository should be under the auspices of the scientific community, rather than governments, although support and resources from governments will be needed to implement the education locally.
 - Materials should be available in a range of languages and should interface with existing

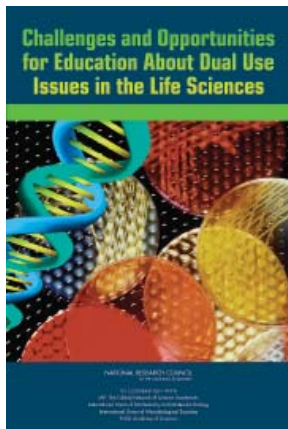
databases and repositories of educational materials dedicated to science education.

- Additional case studies to address broader segments of the life sciences community should be developed.

- **Design methods for commenting and vetting of materials (such as an appropriately monitored Wikipedia model) so they can be improved by faculty, instructors and experts in science education.**
- **Build networks of faculty and instructors through train-the-trainer programs, undertaking this effort, if possible, in cooperation with scientific unions and professional societies and associations.**
- **Develop a range of methods to assess outcomes and, where possible, impacts. These should include qualitative approaches as well as quantitative measures, for example of learning outcomes.**

Read or purchase this report and locate information on related reports at <http://dels.nas.edu/bls>

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The National Academies appointed the above committee of experts to address the specific task requested by the U.S. Department of State. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. This report brief was prepared by the National Research Council based on the committee's report.



For more information, contact the Board on Life Sciences at (202) 334-2187 or visit <http://dels.nas.edu/bls>. Copies of *Challenges and Opportunities for Education About Dual Use Issues in the Life Sciences* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.

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