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Developing a Culture of Awareness: Biological Arms Control, Dual Use Research, and Responsible Conduct of Science

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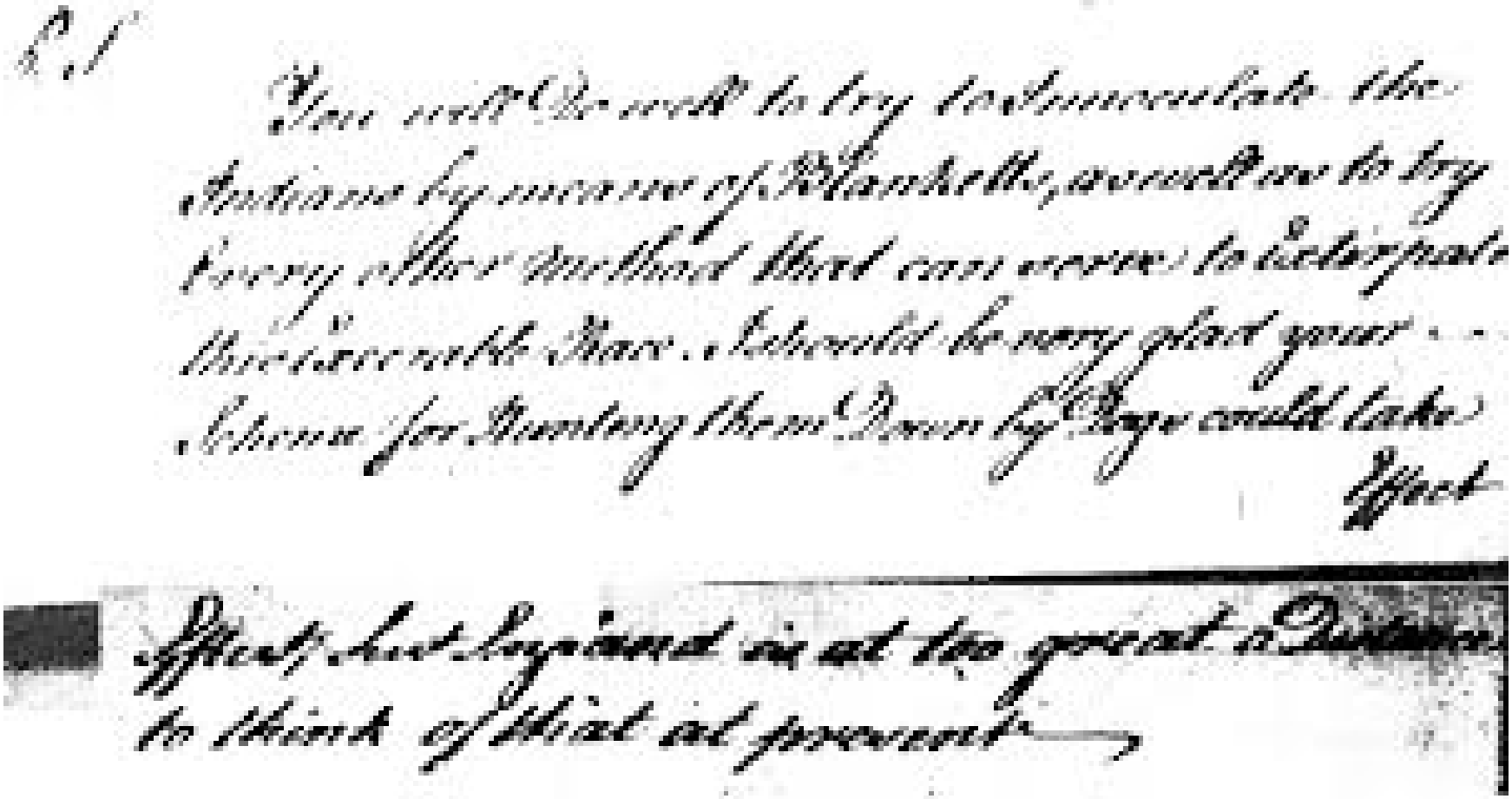
- Biological Arms Control
  - History of biological weapons use
  - The Biological Weapons Convention
  - Technology and the Biological Weapons Convention
- Dual Use Research
  - Early use of the term dual use
  - Examples of dual use research
- Responsible Conduct of Science
  - Can responsible conduct be “taught”?
  - New pedagogical approaches
- Culture of Awareness - Codes of Conduct

Use or intended use of biological agents as a weapon

- Pre-Geneva Convention:
  - Tatars
  - Lord Jeffrey Amherst
  - WWI
- Post-Geneva Convention
  - WWII offensive programs
  - Domestic/terrorism



"You will do well to try to inoculate the Indians by means of blankets, as well as to try every other method that can serve to extirpate this execrable race."

July 7, 1763

Programs during World War I

Programs during World War II

- Mass-produced, battle-ready:
- Anthrax,
- Tularemia,
- brucellosis,
- Q-fever
- VEE
- Botulism
- SEB

- Attempted weaponization: smallpox, EEE and WEE, AHF, Hantavirus, BHF, Lassa fever, glanders, melioidosis, plague, yellow fever, psittacosis, typhus, dengue fever, Rift Valley fever (RVF), CHIKV, late blight of potato, rinderpest, Newcastle disease, bird flu, and ricin.

Source: Croddy, Eric C. and Hart, C. Perez-Armendariz J.2002.

U.S. Program:
Testing BW agents on unsuspecting populations

- **San Francisco, 1950**
  - ***Bacillus globigii* and *Serratia marcescens***
- **Minneapolis and St. Louis 1952-1953:**
  - **zinc cadmium sulfide**
- **NYC subway system, 1966:**
  - ***Bacillus subtilis***

- **Clouds of Secrecy: The Army's Germ Warfare Tests over Populated Areas, by L. A. Cole**

U.S. renounces BW program

- Nixon ordered review of entire BW program
- Concluded that BW were tactically inadequate:
  - latency between exposure and onset
  - difficulty in confining effects to target area
  - increasing antiwar sentiment
- November 1969: unconditional, unilateral renouncement of biological weapons
- February 1970: extended to include toxin agents

Article I of the Biological Weapons Convention

Each State Party to this Convention undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain:

(1) Microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes;

(2) Weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.

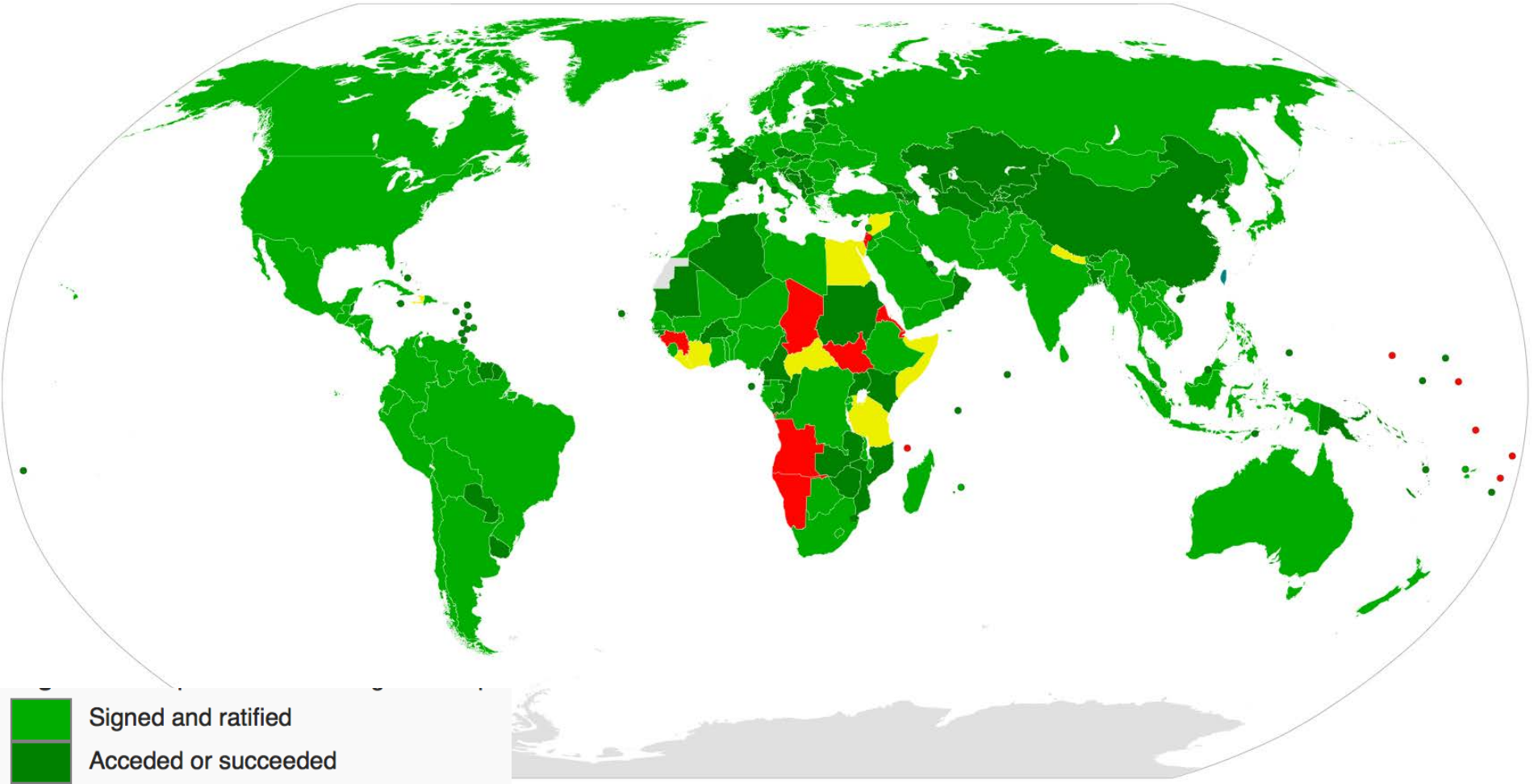
New technologies and the BWC

Dangers arising from technological advances were understood at the time of the treaty's negotiation:

"[t]he potential undoubtedly exists for the design and development of infective agents against which no credible defense is possible, through the genetic and chemical manipulation of these agents".

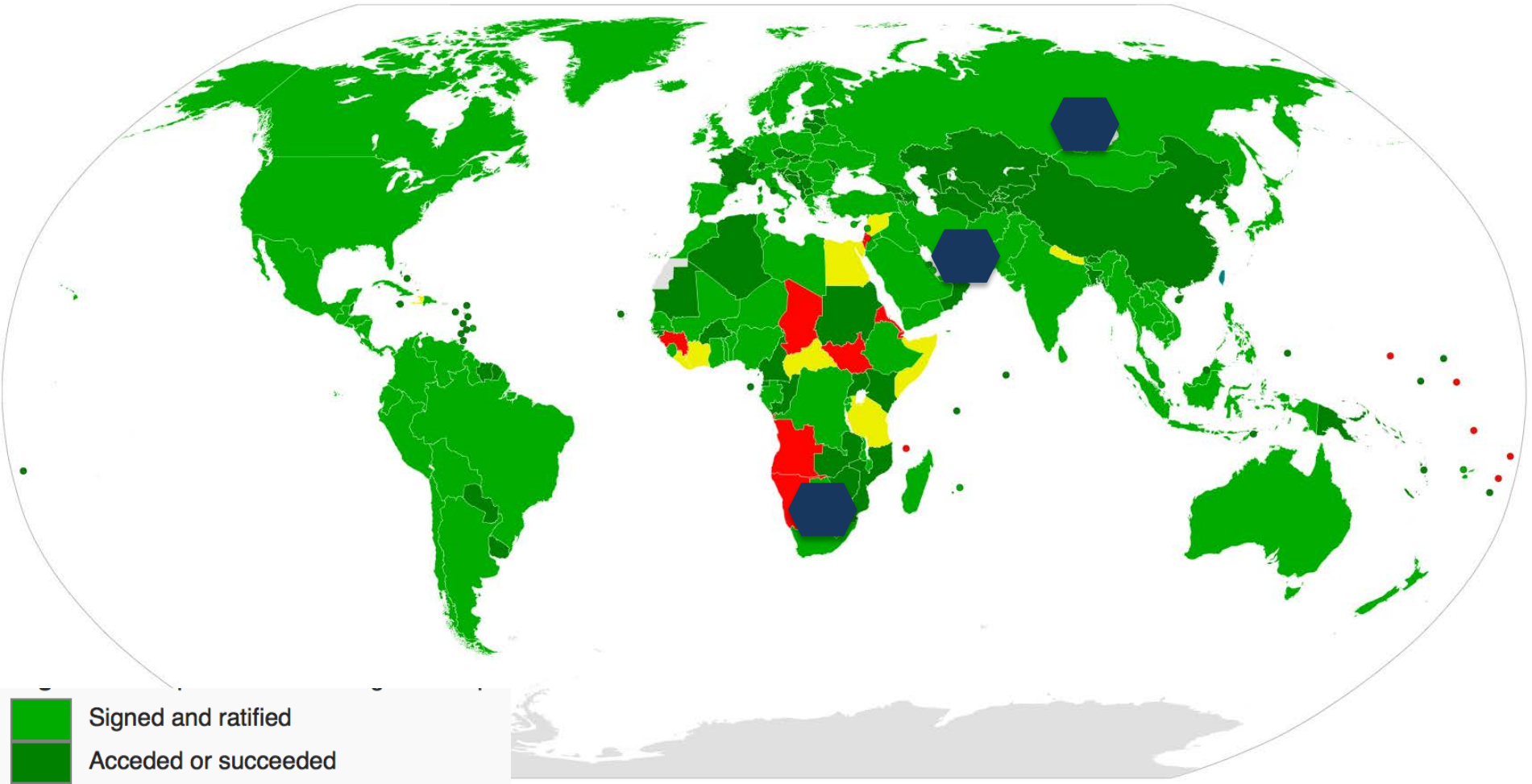
- Joshua Lederberg, United Nations Conference of the Committee on Disarmament on 5 August 1970.

BWC: participation as of Oct 2015



https://commons.wikimedia.org/wiki/File:BWC_Participation.svg

Post-BWC bioweapons developement



https://commons.wikimedia.org/wiki/File:BWC_Participation.svg

Project Coast
1982-1995

- South African scientist Wouter Basson, MD

Anthrax mailings 2001

Source: FBI

- Dual Use Research of Concern (DURC) is life sciences research that, based on current understanding, can be reasonably anticipated to provide knowledge, information, products, or technologies that could be directly misapplied to pose a significant threat with broad potential consequences to public health and safety, agricultural crops and other plants, animals, the environment, materiel, or national security.

DURC

- **1992(?) *Legionella*: myelin**
- **1997 *Bacillus cereus*: lipase**
- 2001 Mousepox IL-4
- 2002 Poliovirus synthesis *de novo*
- 2005 1918 influenza resurrection
- 2011 Transmissibility mutants of HPAI
- 2014 Vaccine defeating strains of influenza

High-pathogenic avian flu transmissibility studies

Nature 02 May 2012

“Experiments of Concern”

- Render an animal or human **vaccine ineffective**
- **Confer resistance** to antibiotics or antiviral agents which are used therapeutically to control diseases
- **Enhance the virulence** of a plant, animal, or human pathogen or render a nonpathogen virulent
- **Increase transmissibility** of a pathogen
- **Alter the host range** of a plant, animal, or human pathogen
- Enable the **evasion of diagnostic** or detection modalities
- **Enable the weaponization** of a biological agent or toxin, including environmental stabilization of pathogens

NAS Report

DURC outside the field of microbiology

- Delivery mechanisms
- Immunology
- Cognitive and neurosciences
- Non-lethal weapons
- Nanotechnology
- Industrial chemicals
- Artificial intelligence

REGULATION

ENGINEERING

EDUCATION

Topics in federally-mandated RCR course for all graduate students (1995)

Interpersonal relationships/mentoring
Plagiarism, falsification, fabrication
Publication/authorship
Animal protection
Human subjects protection
Conduct and misconduct in science
Peer review and funding mechanisms
Biomedical ethics
Patents and licensing
Whistle-blowing

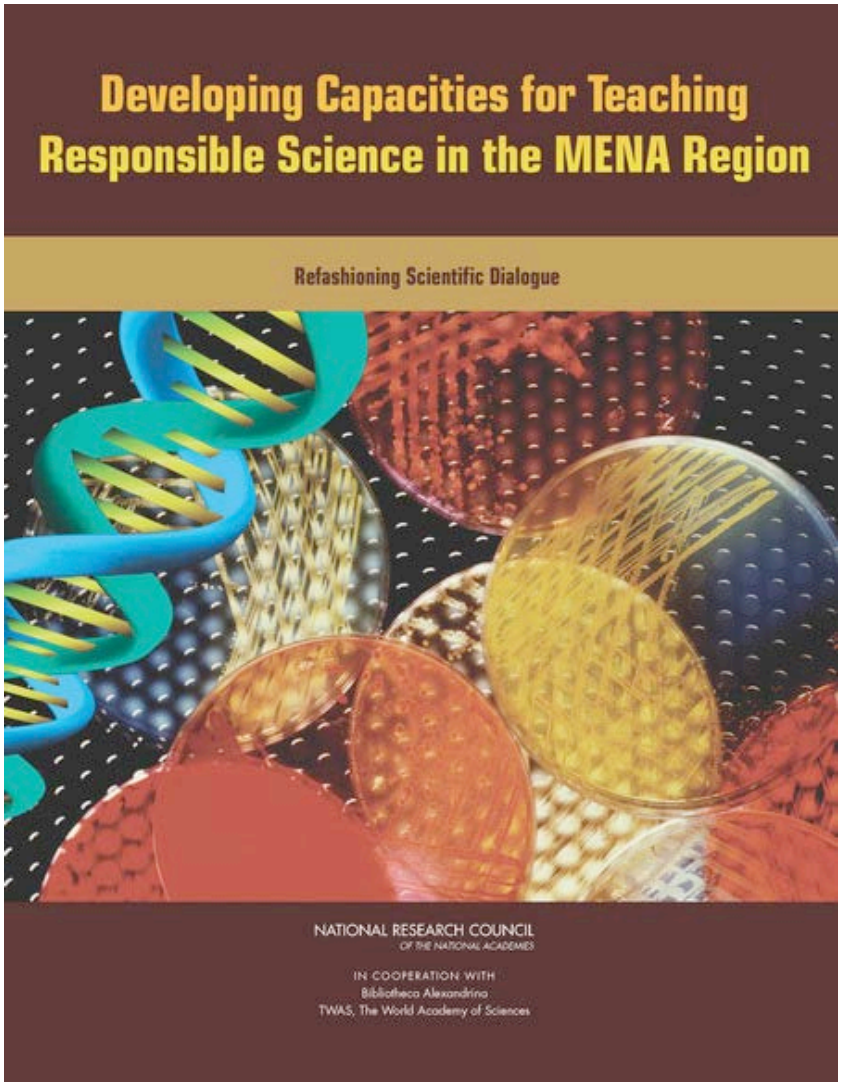
DUAL USE RESEARCH OF CONCERN

Does RCR training work?

- Heitman et al. 2007
  - disheartening lack of knowledge among trainees upon entering graduate school
- Anderson et al., 2007
  - early and mid career NIH-funded scientists who had received NIH-mandated RCR training
- Ante et al. 2010
  - meta-analysis (Antes): overall effectiveness was “modest”
- Novossiolova and Sture 2012
  - ethics education is not enough

Routes to increasing dual use awareness in the research laboratory setting

- 1. Traditional responsible conduct of research training ("RCR"; federally-mandated)
- 2. Institutional Biosafety Committee
- 3. Laboratory Safety training (OSHA)
- 4. Biodefense "certificate"
- *5. "Train the trainer" and active learning*



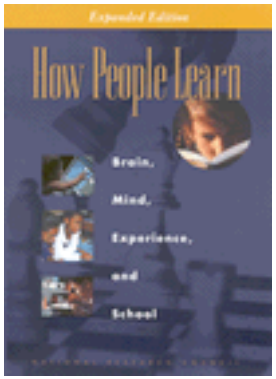
Education and Awareness Raising for Dual Use Issues - The National Academy of Sciences Approach

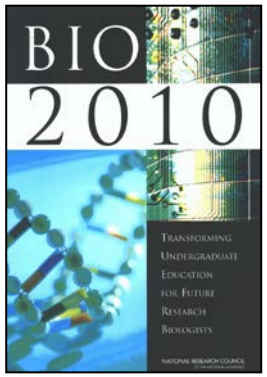
Refashioning Scientific Dialogue

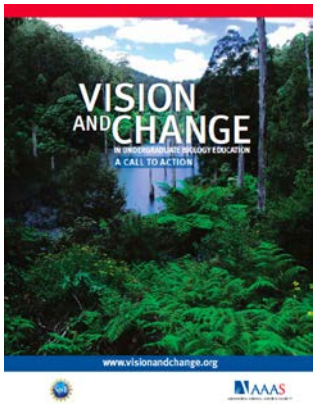
(2013)

NAS international projects have two objectives

1. **Focus on Responsible Conduct of Science as the framework to education and awareness of dual use issues/biorisk management.**
2. **Employ active learning strategies (shown to engage students and improve learning) to teach about Responsible Science and through that, about dual use issues.**







Anestidou, NAS

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

BIBLIOTHECA ALEXANDRINA
مكتبة الإسكندرية

- The goal of the MENA Institutes is to develop a network of faculty in the Middle East/North Africa (MENA) region who are better able to teach issues related to research with dual use potential by combining tenets of responsible science and active learning pedagogical techniques.

- 1) Development of professionalism in science
- 2) Conducting research responsibly
- 3) Being part of the responsible scientific community.

The Institutes

- September 2012, Aqaba, Jordan
- August 2013, Kuala Lumpur, Malaysia
- May 2014, Trieste, Italy
- May 2015, Istanbul, Turkey
- March and July 2015, Egypt I and II
- Workshops on Responsible Science in India
- Workshops in Malaysia
- Workshops on Biosecurity in Indonesia

Active learning techniques

- Case studies
- Concept mapping
- Debate/role-playing
- Jigsaw group projects
- Learn-by-teaching
- Clarification pause
- Backward design
- Assessment mechanisms

…[U]nless some principles of conduct are established for the men and women who manipulate the materials of nature, anarchy will develop, and with anarchy, disaster.”

New Scientist, editorial “Wanted - Code of Conduct” (1968)

Code of Conduct

I pledge, as a research scientist, to uphold to the best of my ability, this covenant:

To work in line with the goals of my fellow colleagues

To do good, and avoid evil in my experiments

To take care that my experiments cannot be easily manipulated for evil

To stay within the bounds of experimentation developed by ethical committees of the world, and my nation: including those of UNESCO (UN Educational, Scientific, and Cultural Organisation)

May I always act to increase the knowledge of science within defined ethical boundaries

If I do not violate this oath, may I be respected by my peers, and those who will exceed my endeavors.

Anonymous student, spring 2015

Beautiful downtown Newark

http://www.huffingtonpost.com/rashawn-davis