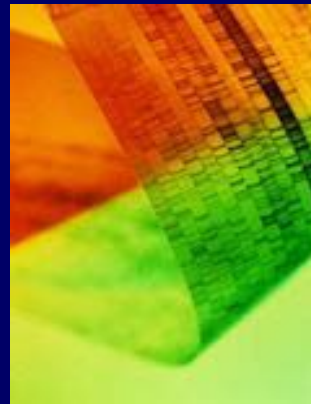
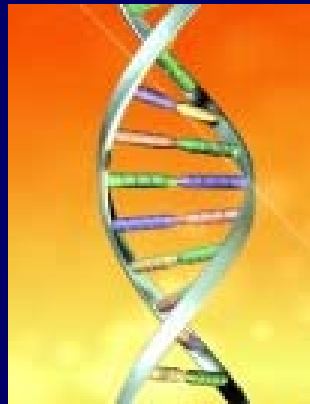


# Commentary



***David A. Relman, M.D.  
Professor of Microbiology & Immunology,  
Professor of Medicine  
Stanford University School of Medicine***

# Comments

David A. Relman

Stanford University

Member, National Science Advisory Board for Biosecurity

Chair, NSABB Working Group on Synthetic Biology

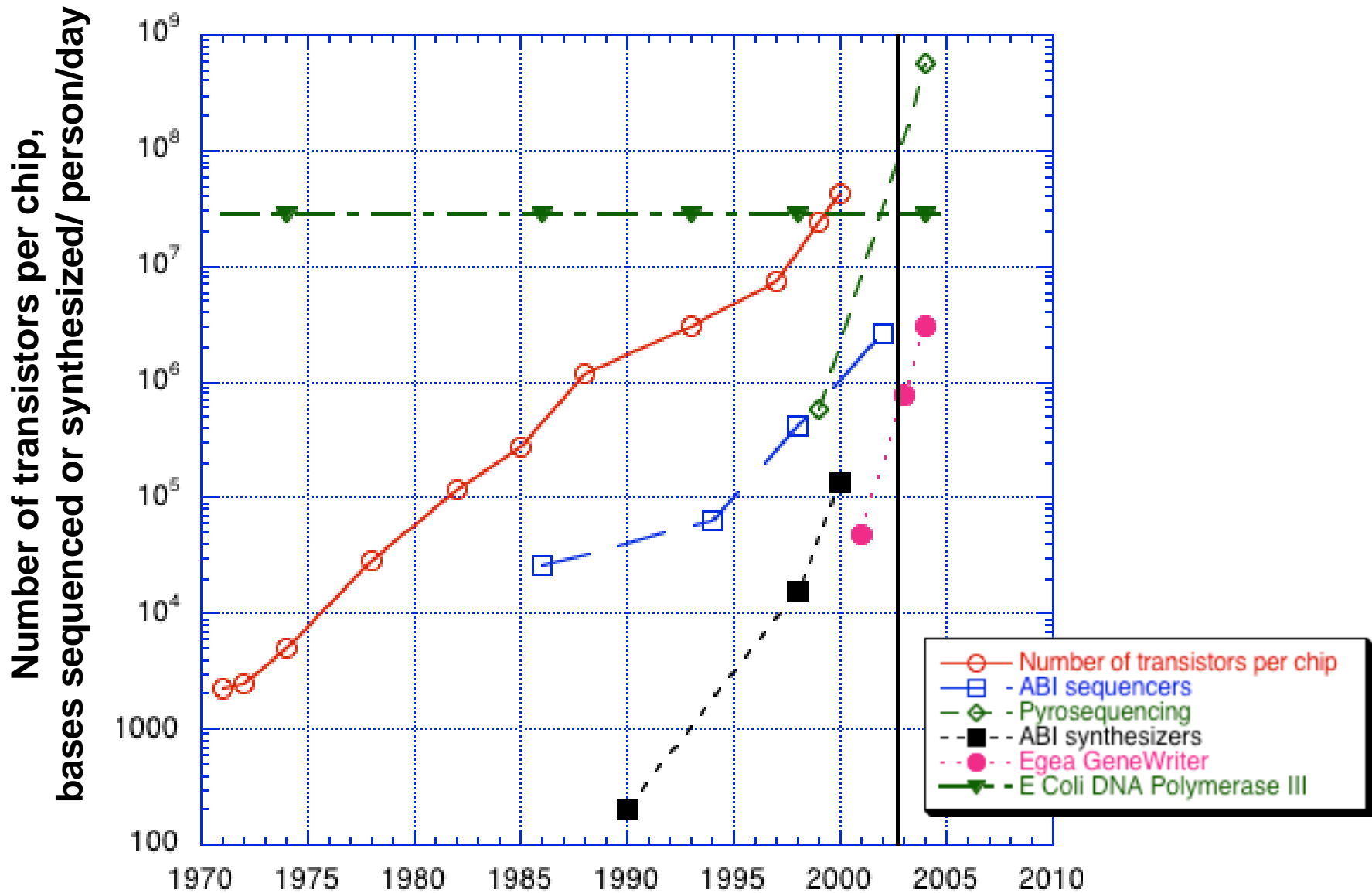
Interactive Webcast

September 22, 2010

# Outline

- Life sciences landscape: time and space
- Cases
- Strategies for mitigating the risk
- Issues for further consideration

# Comparing the pace of biological technologies and Moore's Law (Robert Carlson, 2003)



# Process-based classification of life sciences technologies

1. Acquisition of novel biological or molecular diversity (e.g., DNA synthesis, DNA shuffling, combinatorial chemistry)
2. Directed design (e.g., synthetic biology, reverse genetic engineering)
3. Understanding and manipulating biological systems (e.g., "systems biology", RNAi, modulators of homeostatic systems)
4. Production, packaging, delivery (e.g., microfluidics / microfabrication, nanotechnology, microencapsulation, gene therapy/targeting)

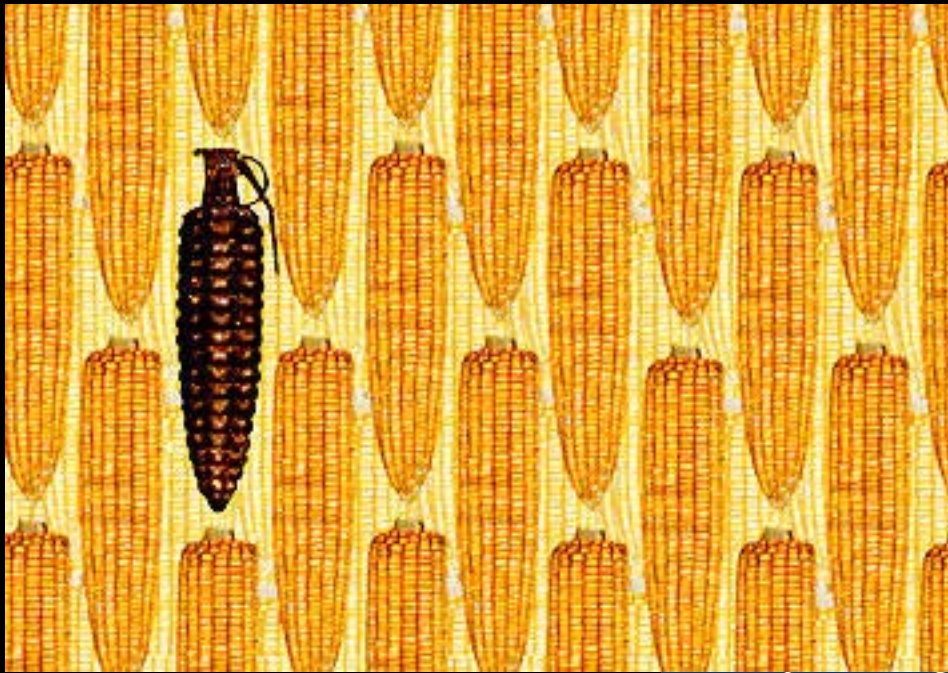
# Commercial DNA Synthesis Foundries

Rob Carlson, University of Washington; Gerald Epstein and Anne Yu, CSIS



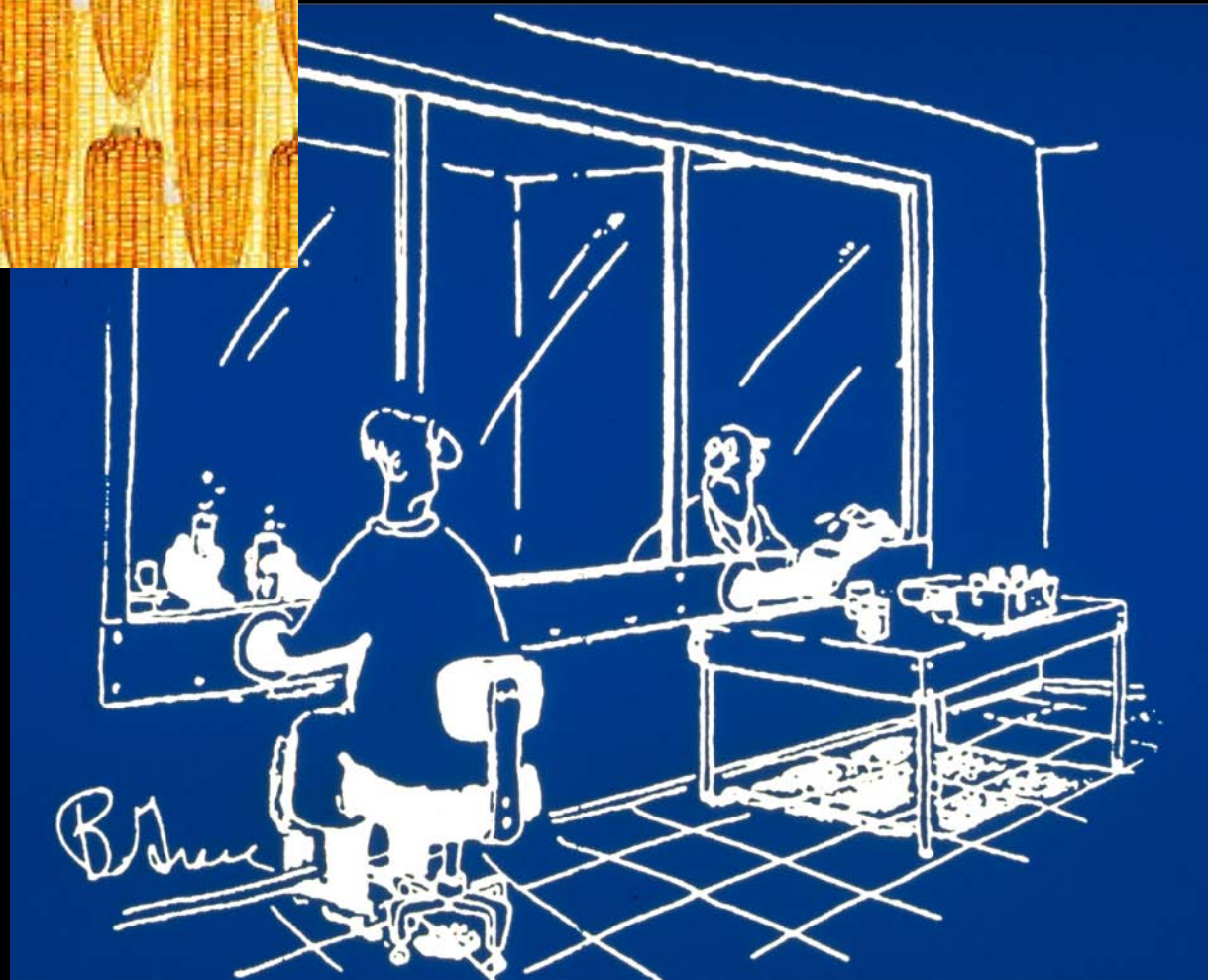
18 July 05. Method: Rough Google search. Thus not a thorough survey. No academic facilities.

Data Source: Rob Carlson, U of W, Seattle  
[www.synthesis.cc](http://www.synthesis.cc), [rob@synthesis.cc](mailto:rob@synthesis.cc)



# Differing perceptions of risk

<http://www.greenpeace.org.uk/>  
"Spot the GM crop"





➔ We are entering "The Biological Century"

[Gregory Benford, 1992]

➔ Unimaginable capabilities, untold benefits,  
unforeseen issues, unavoidable risks



# Dual Use Research of Concern

Research that, based on current understanding, can be reasonably anticipated to provide knowledge, products, or technologies that could be directly misapplied by others to pose a threat to public health and safety, agricultural crops and other plants, animals, the environment, or materiel

# Cases

- Importance of context: sociological (intentions of investigator), scientific
- "directly misapplied"?, scope of impact?
- Trade-offs, not just "black or white"
- Strategies for mitigating risk: measured, independent, complementary...imperfect

# Mitigating the risks

- Outreach, education
- Promote awareness, sensitize relevant communities
  - Self-governance (importance of investigator)
  - Local (professional orgs, academia, industry)
  - National leadership (e.g., NAS, NSABB)
  - International organizations (e.g., UN, ICRC)
- Risk assessment, risk management
- Communication: importance of discussion
- Public health countermeasures:  
flexible, agile, speedy

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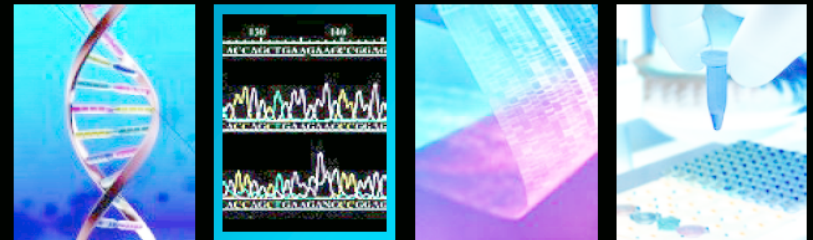
**ADDRESSING BIOSECURITY CONCERNS  
RELATED TO THE SYNTHESIS OF  
SELECT AGENTS**

**DECEMBER 2006**



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**ADDRESSING BIOSECURITY CONCERNS RELATED  
TO SYNTHETIC BIOLOGY**



**Report of the National Science Advisory Board for  
Biosecurity (NSABB)**

**April 2010**



## ➔ We are entering "The Biological Century"

[Gregory Benford, 1992]

- ➔ Unimaginable capabilities, untold benefits, unforeseen issues, unavoidable risks
- ➔ Mitigating the risks: raise awareness, educate, communicate, norms, guidelines, anticipate threats, and promote flexible/agile/rapid/generic biodefense