For "Development of a Model Code of Conduct for Biological Scientists – Tianjin Workshop" side event of 2018 BWC Meetings of Experts, Aug 10, 2018, Geneva, Switzerland

Code of Conduct for Scientists in Life Sciences: Thoughts and experience from Chinese scientific community

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Rapid progress of biotechnologies

Synthetic Biology

- First synthetic circuits—toggle switch and repressilator
- First international conference for synthetic biology held at MIT
- Creation of a microbial cell with a synthetic genome
- Commercial production of artemisinin using engineered yeast
- Redesigning and synthesizing five yeast (eukaryotic) chromosomes

2000-2003
foundational years of synthetic biology

2004-2007
Rapid expansion period of synthetic biology

2008-2013
A dramatic mature of synthetic biology

2014-present
Application transformation of synthetic biology

Gardner, *et al*. *Nature* 403.6767 (2000): 339.
Xie, *et al*., *Science* 355.6329 (2017): eaaf4704.

Genome editing

- Genome editing for various organisms using Cas9/Cpf1
- Gene therapy
- Virus RNA detection using Cas13a

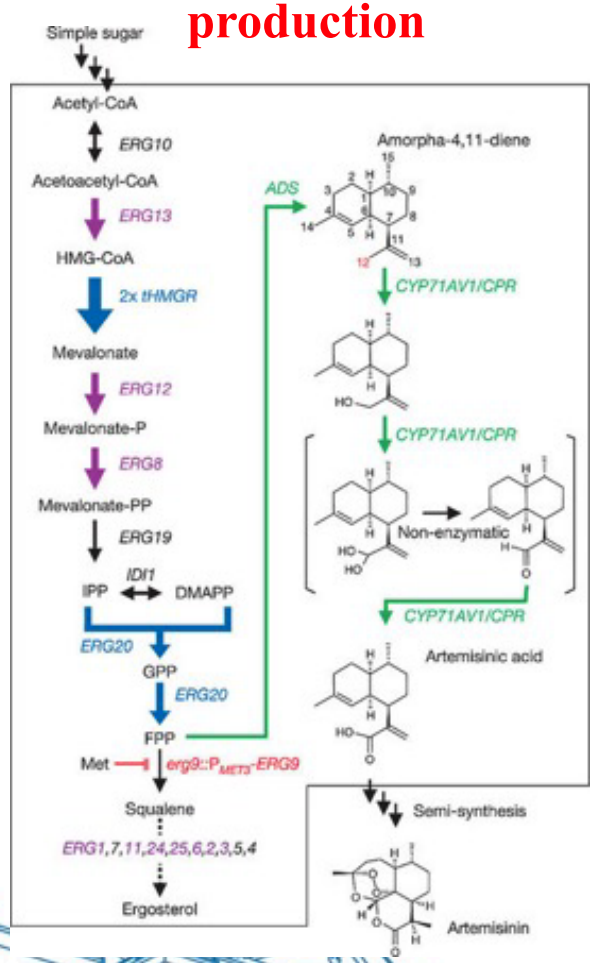
2013-2016
The emergency of new genome editing method-CRISPR/cas

2016-present
Clinic application of CRISPR/cas

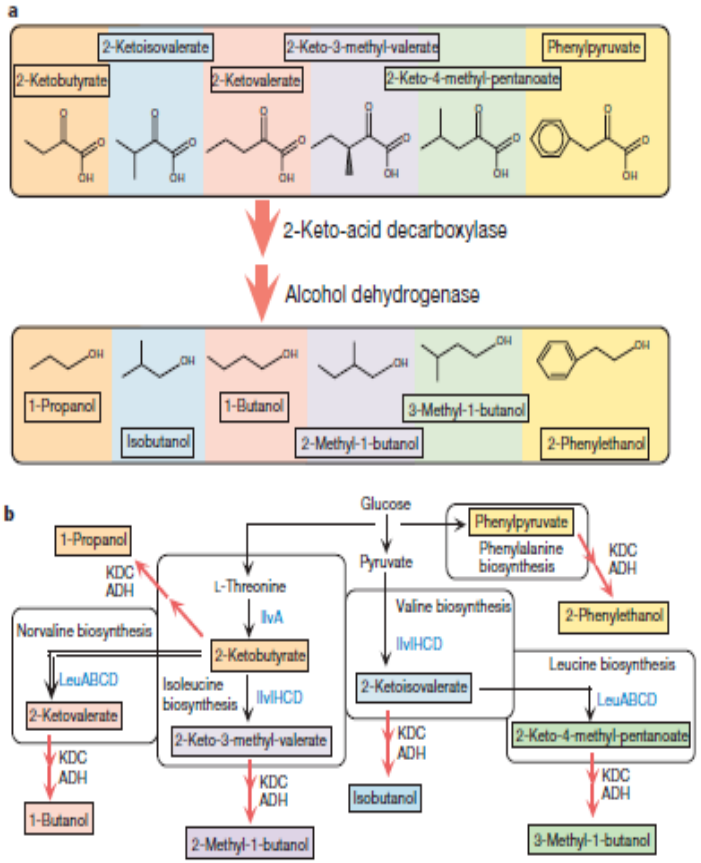
Cong, *et al*. *Science* (2013): 1231143.
Ma, *et al*. *Nature* 548.7668 (2017): 413-419.

Synthetic biology revolutionized traditional biotechnology industry

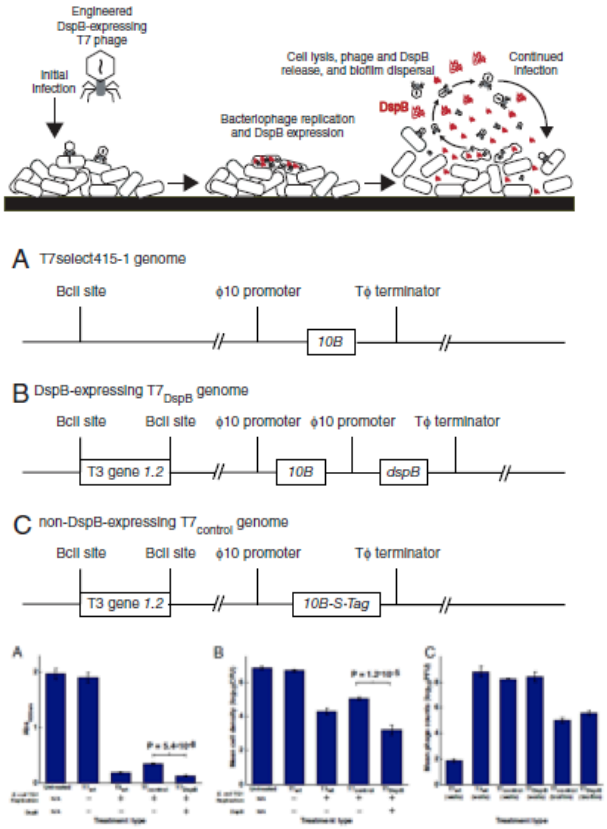
Biopharmaceuticals production



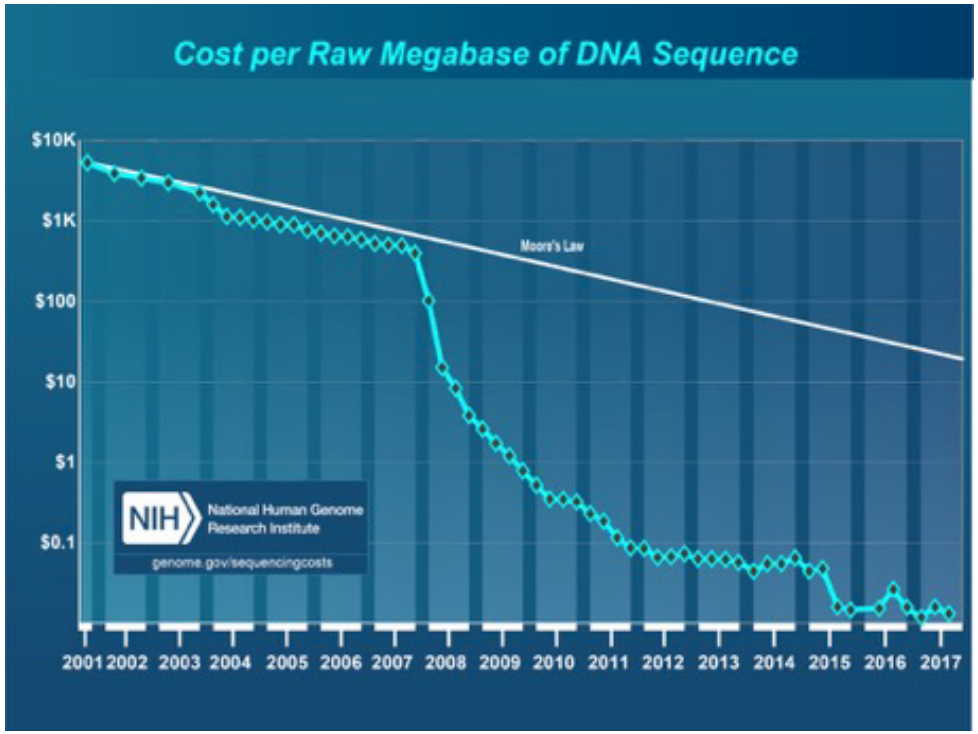
Sustainable chemicals



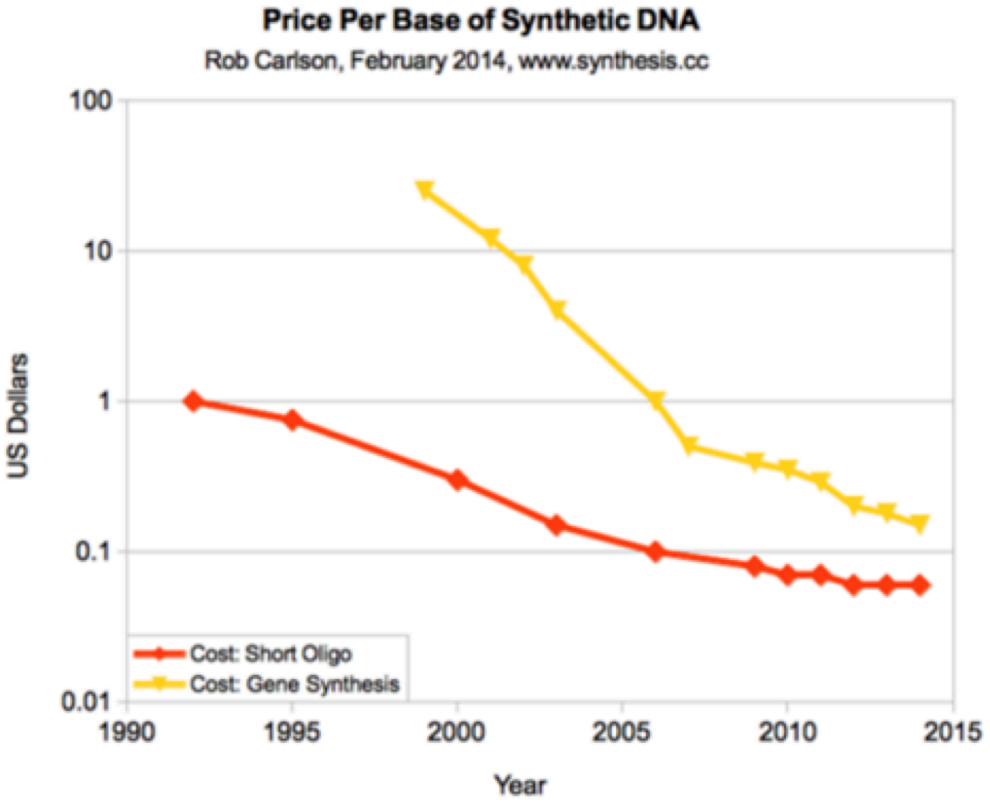
Gene Therapy



Atsumi, *et al.*, *Nature* 451.7174 (2008): 86.
Ro, *et al.*, *Nature* 440.7086 (2006): 940.
Lu, *et al.*, *PNAS* 104.27 (2007): 11197-11202.



https://www.genome.gov/27541954/dna-sequencing-costs/

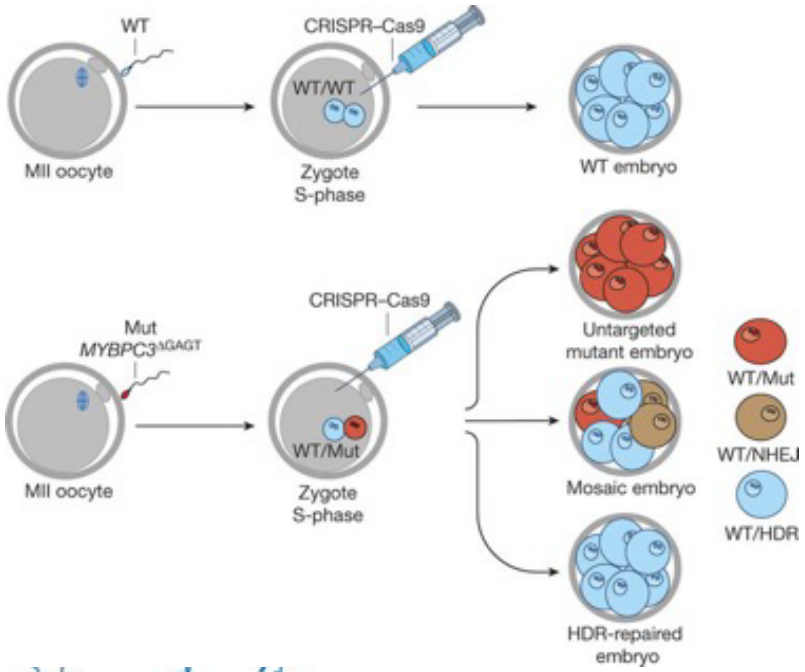


https://synbiobeta.com/time-new-dna-synthesis-sequencing-cost-curves-rob-carlson/

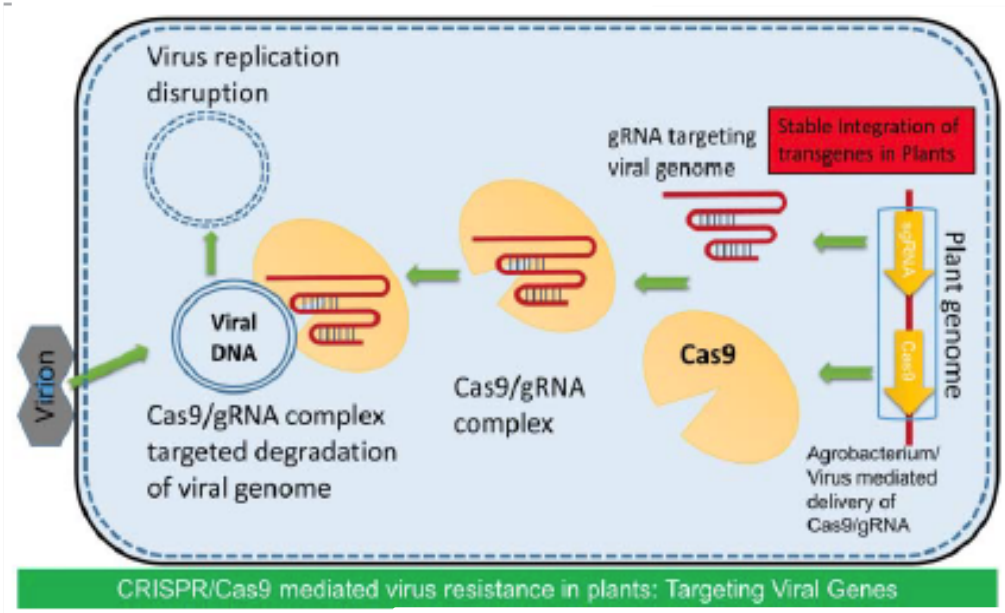
- **Cost of gene sequencing dropped from $1/base pair in 1990 to 34 cents /million base pairs in 2016.**
- **Cost of gene synthesis dropped from $12/base pair in 2001 to 3 cents/base pair in 2016.**

CRISPR/Cas9 provided revolutionary solutions for genome editing of cells

Correction of a disease gene mutation

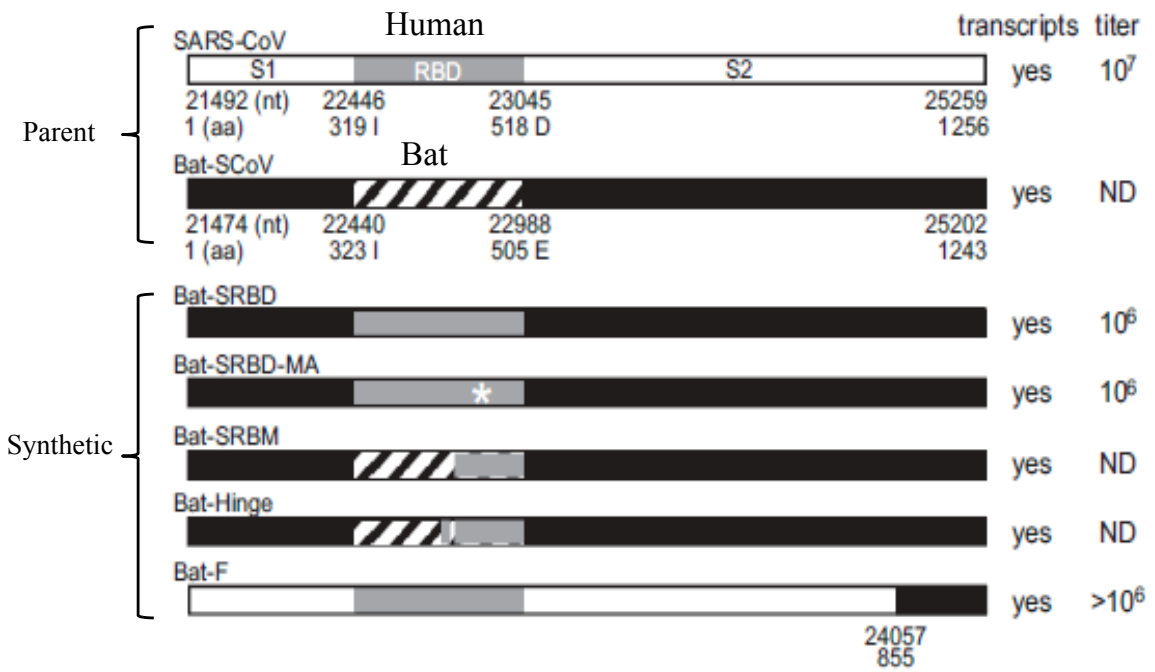


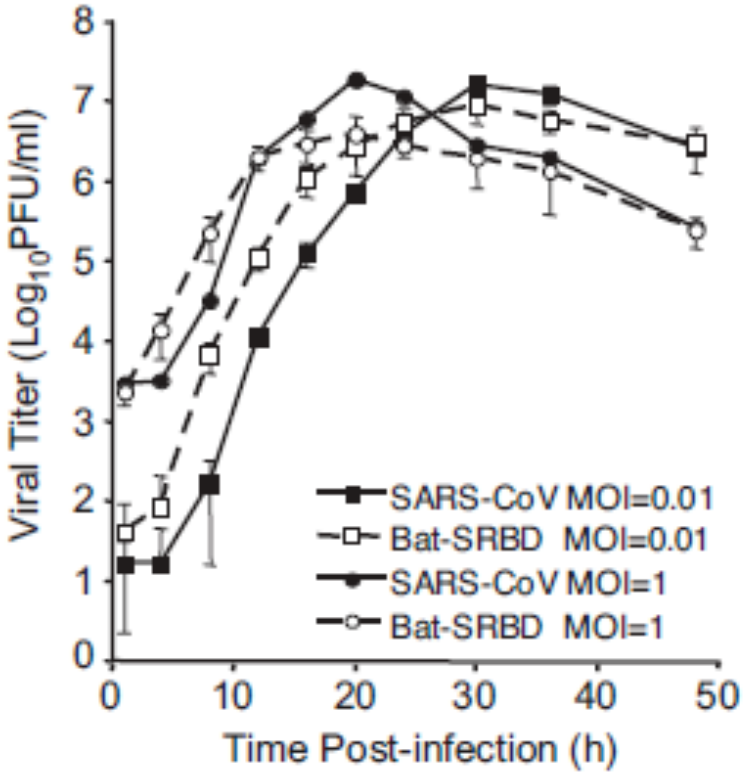
Generation of novel virus-resistant crops



Ma, *et al*. *Nature* 548.7668 (2017): 413-419.
Surender, *et al*. *Bioengineered* 8.3 (2017): 274-279.

Synthetic SARS corona virus carry increased capability of infecting human cells

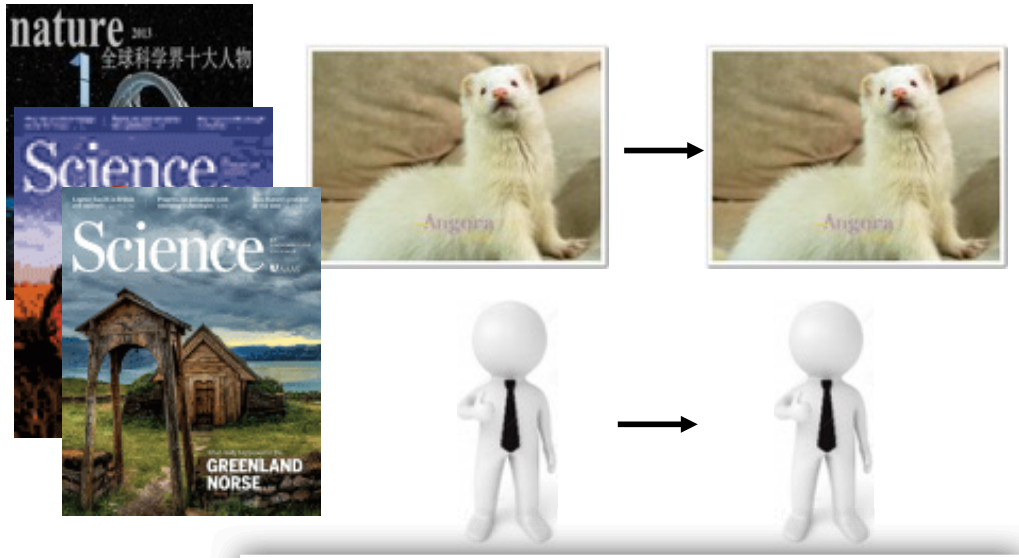




Becker, *et al*, *PNAS* 2008, 105(50): 19944-19949.

Artificial design and chemical synthesis of highly pathogenic virus genome can be easily achieved by synthetic biology

Genetic modification of pathogens can rapidly expand host range and dissemination capabilities



- H5N1 mutants can spread through air in ferrets.
- H7N9 virus can achieve human-to-human transmission by mutating three bases


国务院 新闻 专题 政策 服务 问政 数据 国情

It is forbidden to conduct research related to Ebola and several other virus without permission

任何单位个人不得违规开展埃博拉病毒培养等实验

中央政府门户网站 www.gov.cn 2014-08-21 20:59 来源：新华社

【字体：大 中 小】 打印本页 分享

新华社北京8月21日电（记者 胡浩）记者21日从国家卫生计生委了解到，国家病原微生物实验室生物安全专家委员会卫生专业委员就埃博拉病毒实验室生物安全管理作出决议，要求埃博拉病毒相关实验活动应严格按照《人间传染的病原微生物名录》的要求，在相应的生物安全级别实验室开展实验活动，任何单位和个人不得违规开展埃博拉病毒培养和动物感染等实验活动。

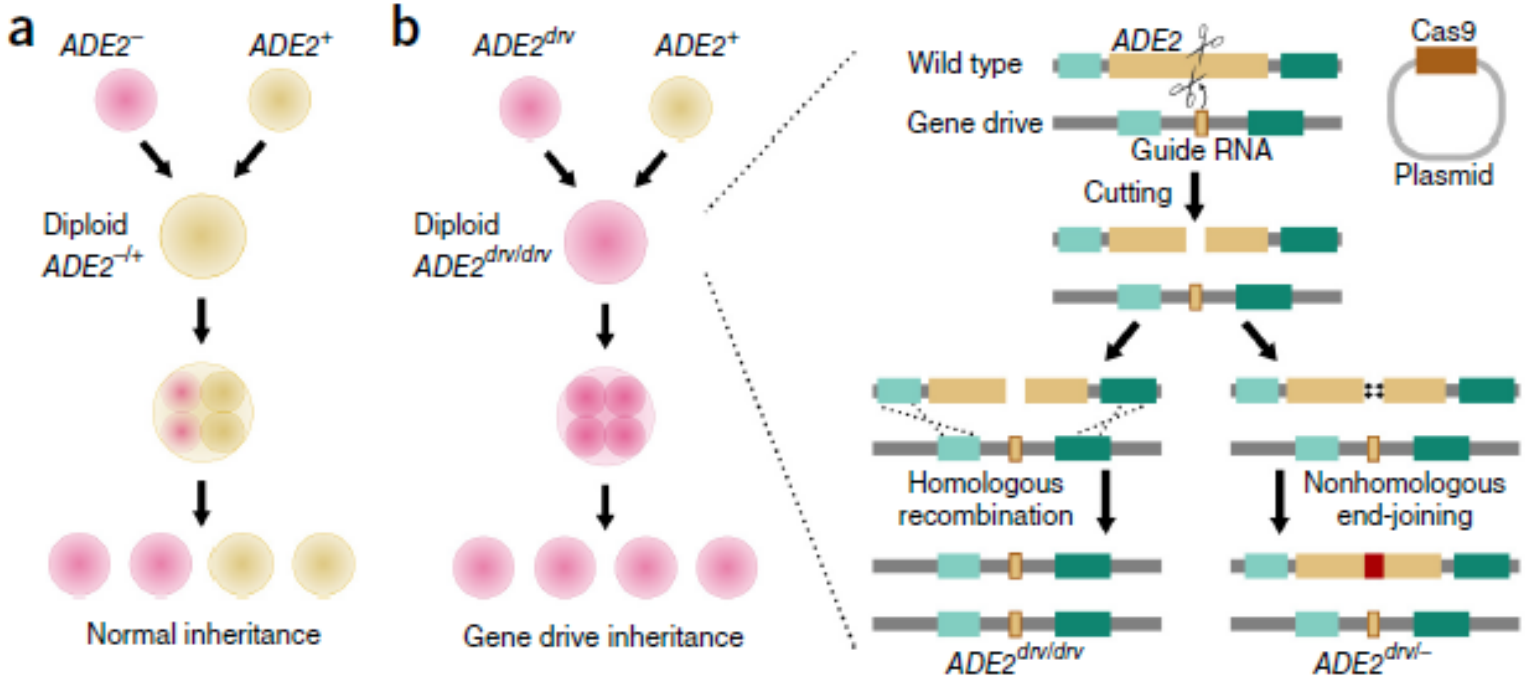
August 21, 2014

U.S. Government Gain-of-Function Deliberative Process and Research Funding Pause on Selected Gain-of-Function Research Involving Influenza, MERS, and SARS Viruses

October 17, 2014

Science. 2013 Jul 26;341(6144):410-4; *Science*. 2013 Jun 21;340(6139):1459-63.
Science. 2012 Jun 22;336(6088):1534-41; *Nature*. 2012 May 2;486(7403):420-8.

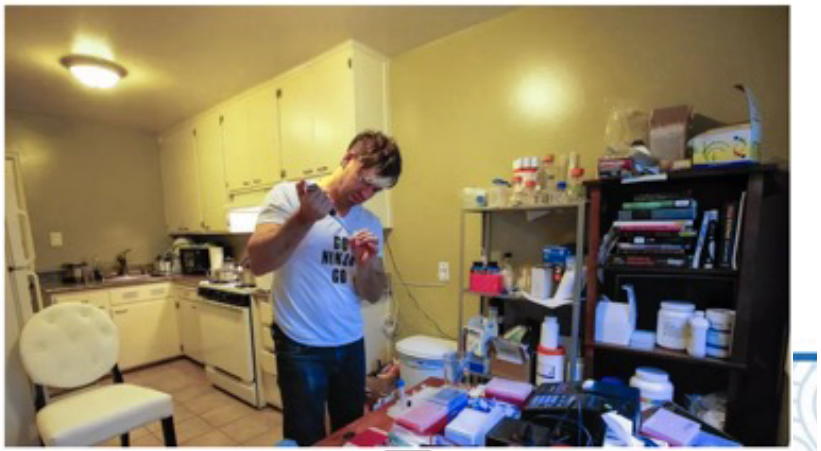
Potential risks of misuse or destructive use of gene drive



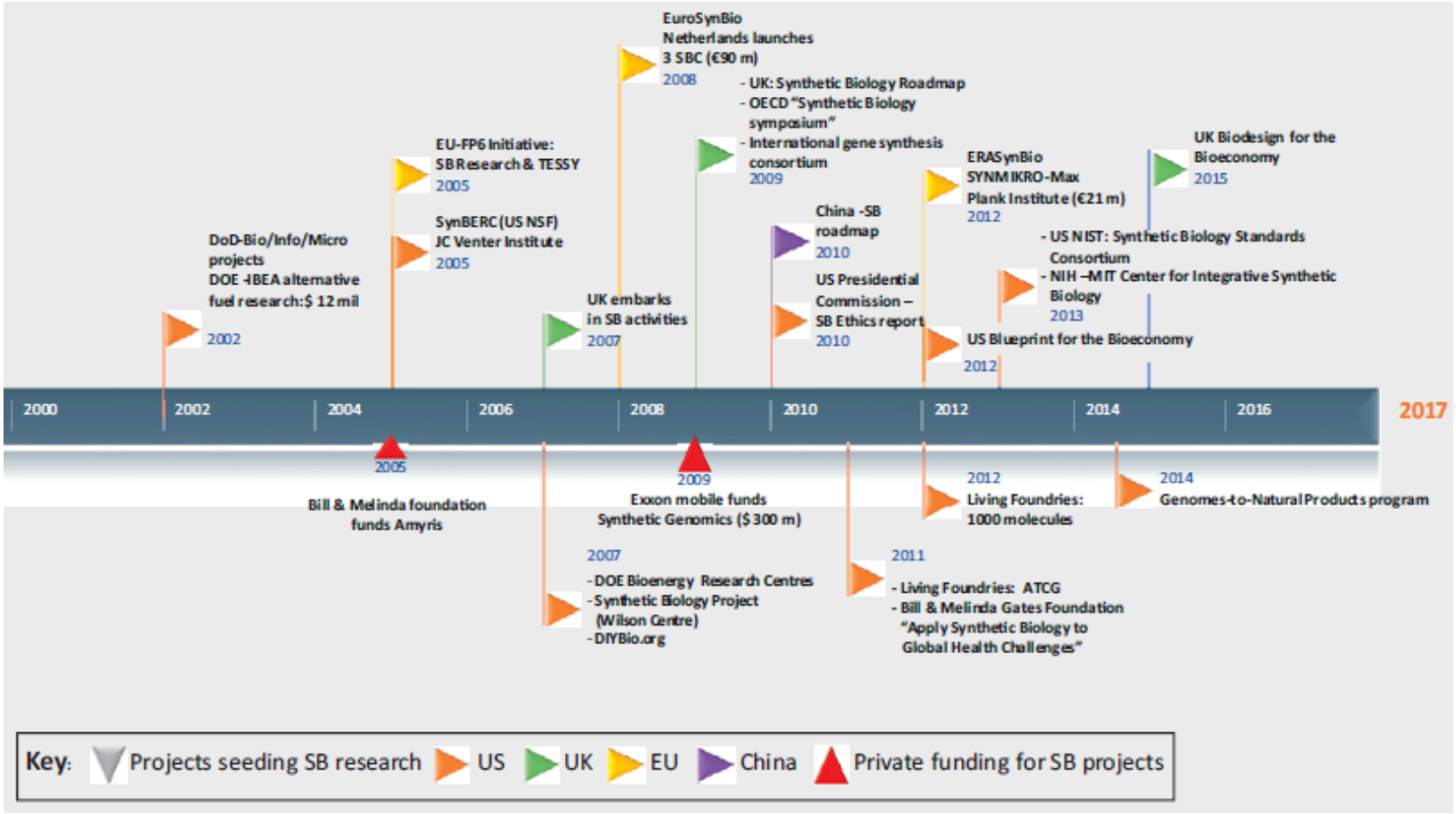
1. Causing damages to selective species
2. Breaking the nature balance of ecosystems

Hammond, *et al*. *Nature Biotechnology* 34.1 (2016): 78.

Rapid increase of amateur/do-it-yourself (DIY) biology groups



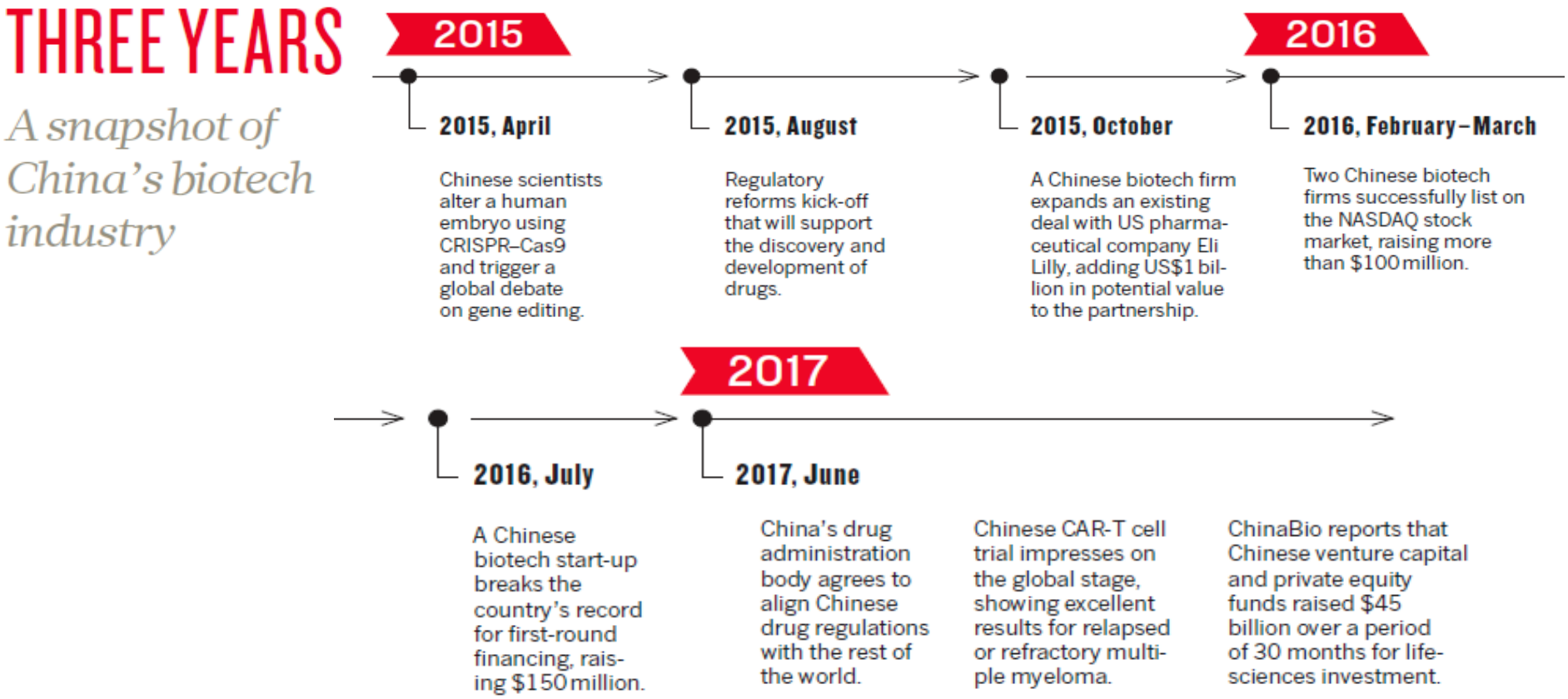
Major initiatives in Synthetic Biology



Bueso and Tangney. *Trends in Biotechnology* 35.5 (2017): 373-378.

1. Since 2005, ~1 billion dollars invested in synthetic biology research in USA.
2. From 2004 to 2013, ~450 million euro was invested into synthetic biology field in EU.
3. Since 2007， over 300 million pounds have been invested into synthetic biology in UK.
4. Since 2011, ~200 million invested in Synthetic Biology Research (2011-2015), and 1 billion planned for 2019-2023 in China.

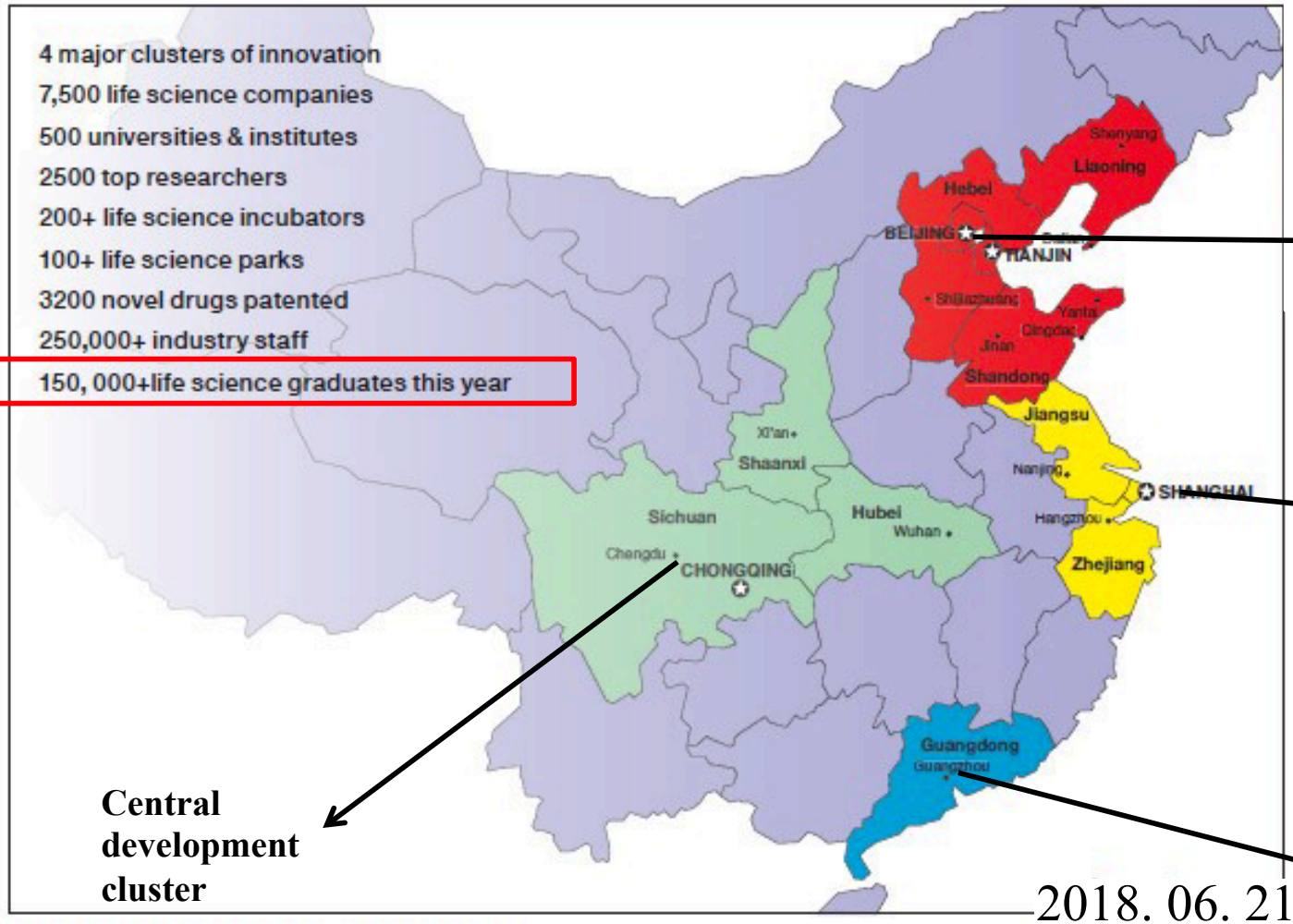
Fast growth of biotechnology R&D in China



The latest five-year plan, China's thirteenth, stipulates that the biotechnology sector should **exceed 4%** of gross domestic product (GDP) by 2020 and that there should be **10 to 20 life-science parks** for biomedicine with an output surpassing 10 billion yuan (US$1.5 billion).

------***Biotech Booms in China (Career guide, Nature, Jan 2018)***

Fast growth of new biotechnology research and industry in China



Beijing as center

Shanghai as center

Central development cluster

Guangzhou as center

2018. 06. 21

How to balance the rapid development of biotechnology and biosafety requirements?

Key issues need to be considered:

1. What and where are the real threat when dual-use technology is applied
2. Roles and responsibilities when conducting science and publishing scientific outcomes
3. Education and training for a rapidly expanding populations who engage in life science
4. Regulatory mechanisms of institutes or entities
5. Public engagement
6. …..

Goals:

I. To standardize biotechnology research and development activities

II. To promote and ensure the healthy and orderly development of biotechnology research and development activities

III. To safeguard national biosafety

"Safety Management Guidelines for Biotechnological R&D"

Issued by Ministry of Sciences and Technology of China on July 12, 2017

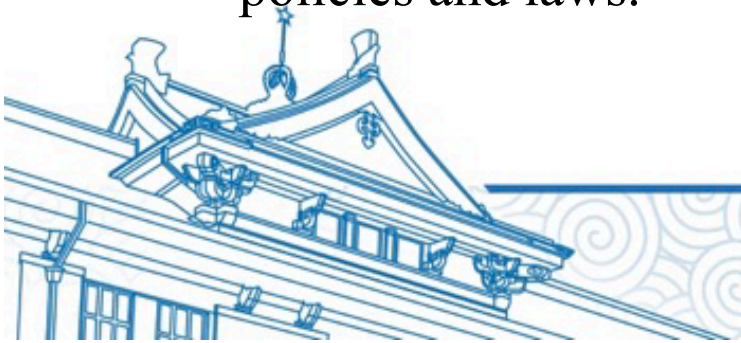
I. Relevant research activity and its commercialization should be systematically assessed according to risk levels of the proposed research.

II. Relevant ethics and law should be applied throughout the research process.

III. Responsibility of the State Council, institutions and individual researchers is define. For example, roles of State Council includes development of management practices, recommendation of risk level list, the presentation of countermeasures and disposal procedures; and role of Institutes includes inspections and supervision etc.

IV. Risk and accident reporting and management protocol proposed.

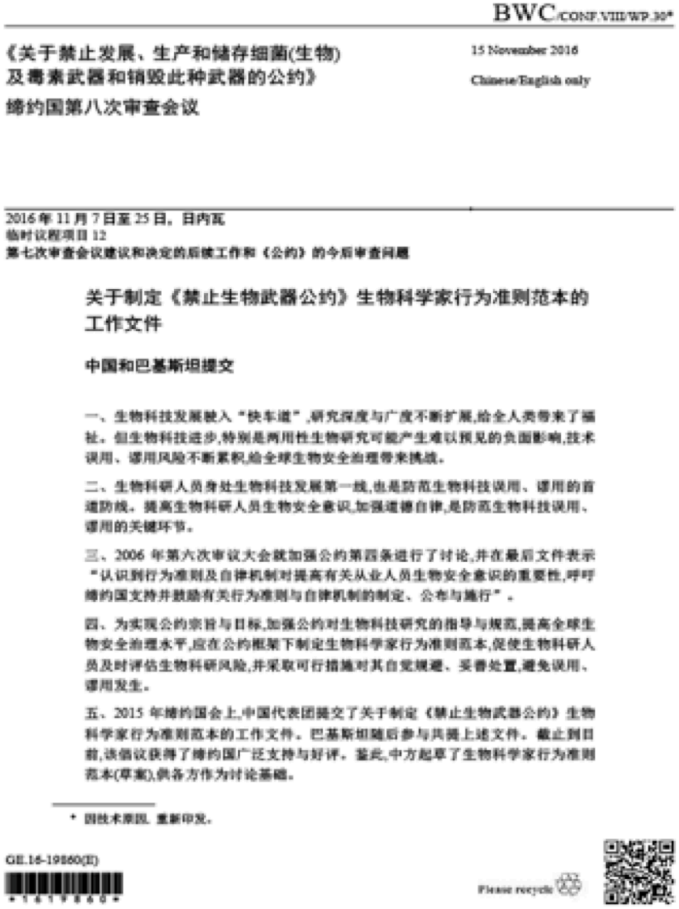
V. Policy related to international collaboration should follow biosafety related policies and laws.



Chinese government and scientific community pay great attention to biosafety issues of dual-use biotechnology

Biosafety Key Technologies Research and Development Key Program (2016-2020)	Synthetic Biology Key Program (2018-2022)
This key program has been a sub-program of National Key Research and Development Program funded by Ministry of Science and Technology since 2016. **"Building scientific, technological and policy support capability for national biosafety system"**	It is also a sub-program of National Key Research and Development Program. A project entitled **"Synthetic Biology Ethics Assessment, Policies and Regulations and Public Education Popular Science System Construction"** has been added into this key program this year.

International Level - Code of Conduct for Scientists



BWC/CONF.VIII/WP.30*

《关于禁止发展、生产和储存细菌(生物)及毒素武器和销毁此种武器的公约》缔约国第八次审查会议

15 November 2016

Chinese/English only

2016年11月7日至25日，日内瓦
临时议程项目12
第七次审查会议建议和决定的后续工作和《公约》的今后审查问题

关于制定《禁止生物武器公约》生物科学家行为准则范本的工作文件

中国和巴基斯坦提交

一、生物科技发展驶入“快车道”，研究深度与广度不断扩展，给全人类带来了福祉。但生物科技进步，特别是两用性生物研究可能产生难以预见的负面影响，技术误用、谬用风险不断累积，给全球生物安全治理带来挑战。

二、生物科研人员身处生物科技发展第一线，也是防范生物科技误用、谬用的首道防线。提高生物科研人员生物安全意识，加强道德自律，是防范生物科技误用、谬用的关键环节。

三、2006年第六次审议大会就加强公约第四条进行了讨论，并在最后文件表示“认识到行为准则及自律机制对提高有关从业人员生物安全意识的重要性，呼吁缔约国支持并鼓励有关行为准则与自律机制的制定、公布与施行”。

四、为实现公约宗旨与目标，加强公约对生物科技研究的指导与规范，提高全球生物安全治理水平，应在公约框架下制定生物科学家行为准则范本，促使生物科研人员及时评估生物科研风险，并采取可行措施对其自觉规避、妥善处置，避免误用、谬用发生。

五、2015年缔约国会上，中国代表团提交了关于制定《禁止生物武器公约》生物科学家行为准则范本的工作文件。巴基斯坦随后参与共提上述文件。截止到目前，该倡议获得了缔约国广泛支持与好评。鉴此，中方起草了生物科学家行为准则范本(草案)，供各方作为讨论基础。

* 因技术原因，重新印发。

GE.16-19860(E)

Please recycle

Recommendations and Principles

1. Ethical conduct
2. Law constraint
3. Scientific Integrity
4. Respect to scientific objects
5. Research establishment and process
6. Constraints on the dissemination of results
7. Scientific research dissemination
8. The institution
9 . International exchange

Code of conduct for scientists“ provide a important step towards the governance of dual-use biotechnology

- The proposed code of conduct a positive contribution to the Convention.
- Aspirational codes have been used successfully in other scientific fields to encourage a culture of responsible conduct and reinforce important norms.
- The field of biological sciences would benefit from its own code, as would the Biological Weapons Convention.

Participants were divided into four groups and asked to consider the following six key questions:

1 Who should be the target audience for the code?

The target audience for the code was individual life scientists and managers engaged in all steps of life science research.

2 What should be the basic principles of the code?

General approval of the elements within the code, but with agreement that **education** and **awareness-raising** should be added.

3. What type of code should it be?

The code was seen by all groups as an Aspirational Code that could set an internationally agreed standard to be adjusted to fit varying national and professional circumstances in Advisory Codes and Enforceable Codes.

4. How should the code be promoted?

Various routes were put forward that could be used to promote the code, in particular the BTWC meetings in 2018. Other include working through the National Academies, Scientific Association or InterAcademy Panel etc.

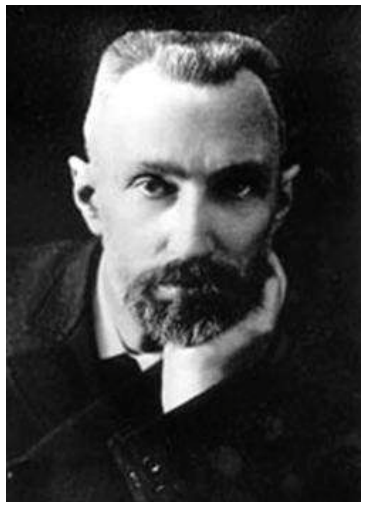
5. What measures should be taken to sustain the code?

To reach that goal, the implementation of the code may need measures such as education and regulatory oversight where necessary.

6. How should the impact of the code be evaluated?

Evaluation was seen as a difficult problem by all of the groups, but one idea suggested by all groups was for States Parties to add a section on the implementation of the code in their annual Confidence Building Measures return to the ISU.

"I am one of those who think like Nobel, that humanity will draw more good than evil from new discoveries"



Pierre Curie

Speech upon acceptance of the Nobel Price in Physics in 1903, with Marie Curie and Henri Becquerel for "their discovery of spontaneous radioactivity"

天津大学生物安全战略研究中心
Tianjin University Center for Biosafety Research and Strategy (CBRS)

Thanks!

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