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Synthetic Biology: Opportunities and Governance

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Technology + Society ->? Future, Podgorica, Montenegro, 19-20 May 2016

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Three global networks of academies:

March 2016: IAP General Assembly, Hermanus, South Africa IAP, IAC and IAMP member academies voted to join forces under the umbrella of the InterAcademy Partnership.

- **'IAP for Science'** iap the global network of science academies

- formerly IAP - the global network of science academies

- **'IAP for Research'** InterAcademy Council

- formerly the InterAcademy Council (IAC)

- **'IAP for Health'** iamp

- formerly the InterAcacdemy Medical Panel (IAMP).

Membership

More than 130 national, regional and global academies

IAP for Science

IAP for Health
78 members, of which
52 also belong to IAP for Science

Strategic Priorities

- Provide evidence-based advice and perspectives on global issues.
- Strengthen the global scientific enterprise.
- Cultivate a scientifically literate global society.
- Strengthen the global network, including supporting the creation of new academies in countries where they are not yet present.

IAP's engagement in the area of synthetic biology touches on three of these strategic objectives.

First: What is Synthetic Biology

According to the IAP Statement:
Synthetic biology is the deliberate design and construction of customised biological and biochemical systems to perform new or improved functions.

According to the CBD's new "operational definition":
Synthetic biology is a further development and new dimension of modern biotechnology that combines science, technology and engineering to facilitate and accelerate the understanding, design, redesign, manufacture and/or modification of genetic materials, living organisms and biological systems.

Landmarks in Synthetic Biology

Creation of a chemically-synthesized genome
Gibson, D.G. *et al*. (2010) *Science*.

Development of various genome editing methods
e.g. CRISPR-Cas9, TALENS

Development of 'mutagenic chain reaction' or 'gene drive' methods
Gantz, V.M. and Bier, E. (2015) *Science*.

Definition of the genome requirements for a minimal cell
Hutchison III, C.A. *et al*. (2016) *Science*.

Credit: Science,10 May 2016

Credit: Wikipedia

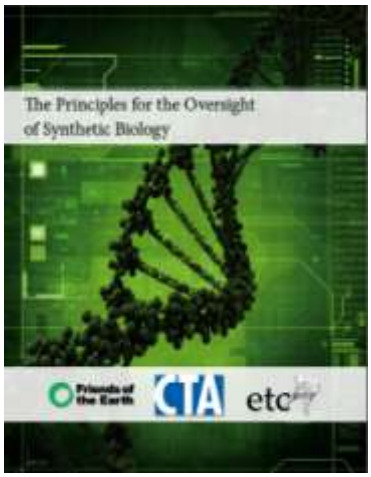
Potential of Synthetic Biology

Robotic labs and high-throughput screening make the generation of new clones and reconfigured genomes orders of magnitude faster compared to just 10 years ago.

Optimization of bioreactor parameters can produce 'industrial' levels of compounds that were once rare or difficult to isolate, e.g. ginsenosides, artemisinin.

Core facilities, Tianjin Institute of Industrial Biotechnology, CAS

Resistance to Synthetic Biology



This document outlines the following principles necessary for the effective assessment and oversight of the emerging field of synthetic biology:

I. Employ the Precautionary Principle
II. Require mandatory synthetic biology-specific regulations
III. Protect public health and worker safety
IV. Protect the environment
V. Guarantee the right-to-know and democratic participation
VI. Require corporate accountability and manufacturer liability
VII. Protect economic and environmental justice

Governmental bodies, international organizations and relevant parties must immediately implement strong precautionary and comprehensive oversight mechanisms enacting, incorporating and internalizing these basic principles. Until that time, there must be a moratorium on the release and commercial use of synthetic organisms and their products to prevent direct or indirect harm to people and the environment.[1]

IAP Statement on Synthetic Biology

Statement released on 7 May 2014
• Parallel World View article in *Nature.*
• Timed to coincide with discussions on a possible moratorium on synthetic biology at meetings of the Convention on Biological Diversity.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IAP Statement on Realising Global Potential in Synthetic Biology: Scientific Opportunities and Good Governance


WORLD VIEW

Time to settle the synthetic controversy

If synthetic biology is to thrive, the world needs to decide now how the field should be regulated and supported, says Volker ter Meulen.

BEYOND DIVISIONS

Statement makes 5 recommendations
• Parallel World View article in *Nature.*
• Timed to coincide with discussions on a possible moratorium on synthetic biology at meetings of the Convention on Biological Diversity.

IAP Statement on Synthetic Biology

Strategic Priority 1:
- Provide evidence-based advice and perspectives on global issues.

Statement makes 5 recommendations:
• Prepare researchers for work in synthetic biology;
• Engage with the public and clarify ethical and social concerns;
• Consider alternative models for owning and sharing research outputs;
• Determine how synthetic biology should be regulated;
• Disseminate guidelines and call for scientific responsibility.


Credit: Nature, 14 April 2016


Credit: Nature, 29 Sept 2015

Strategic Priority 1:

- Provide evidence-based advice and perspectives on global issues.

The IAP Biosecurity Working Group (www.iapbwg.pan.pl) engages with the UN Biological and Toxin Weapons Convention

Ryszard Slomski, Polish Academy of Sciences and chair of the IAP Biosecurity Working Group, with Jo Husbands, US NAS, at a meeting of experts of the Biological and Toxin Weapons Convention, Geneva, August 2015.

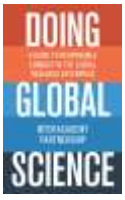
Strategic Priority 2:

- Strengthen the global scientific enterprise.

Publications, activities and outreach highlighting dual-use research and responsible conduct of research.

Statement recommendations:
• Prepare researchers for work in synthetic biology.

2014: Policymakers' and Practitioners' Awareness Workshop on Dual-use Education
Islamabad, Pakistan, 29-30 March 2014



2016: Doing Global Science: A Guide to Responsible Conduct in the Global Research Enterprise

Strategic Priority 3:

- Build a scientifically literate global society.

Statement recommendation:

- Engage with the public and clarify ethical and social concerns.

The IAP Science Education Programme, as well as the regional affiliated networks, also undertake science communication/science literacy activities.

Statement recommendations:

- Prepare researchers for work in synthetic biology;
- Engage with the public and clarify ethical and social concerns.

Session on:

Science Advice in the International Arena with a Special Focus on Synthetic Biology

Conclusions:

- Science is moving quickly, but regulations are not keeping up;
- Many synthetic biology practitioners outside academia so difficult to ensure responsible and ethical research;
- Public has reacted negatively to GMOs. Can we avoid the same with new synthetic biology products/ organisms?
- Need for code of conduct especially for informal community;
- Can we use the 'hackers' to control the 'spammers' – need to engage with the DIY community;
- Communities operate in mentor/mentee relationships. Need to engage with these communities to flag potential misuse.

www.diybio.org

Local groups in USA, Canada, plus 28 European cities, including Budapest, Graz, Kiev, Maribor, plus 5 groups each in Asia and Latin America and 4 in Oceana.

Codes

IGEM 2016 Competition

Apply to be an iGEM judge and help evaluate synthetic biology projects from today's brightest students, discover new ideas, and share your expertise.
NEW: Instructor judges will receive a 50% discount on their Jamboree attendance fee!




- The IAP Statement on Synthetic Biology was a timely release and has contributed to the debate on synthetic biology;
- However, the scientific establishment has generally lagged behind, while informal groups have developed a pro-active culture of responsibility;
- Next step for IAP, in partnership with the Global Young Academy, is to engage these informal groups;
- National academies of science can use the IAP Statement, promote its recommendations, and continue to engage with other sectors to enhance understanding of synthetic biology and its potential for good.

Thank you!

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