Technologies that can be **rapidly** deployed to **assess genetic status** to predict susceptibility to environment and physical stressors.

Ashley Connolly

Flinders University

Centre for Nanoscale Science and Technology

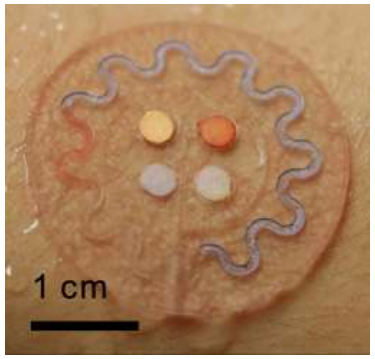
Rapid Analysis

Stickers

UV

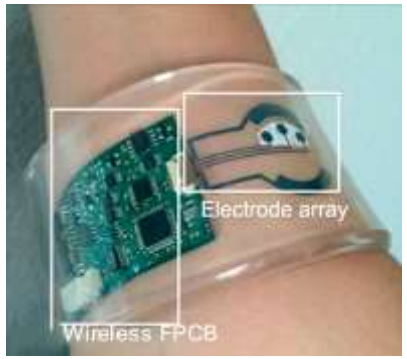
Fit Bit

Distance
Heart



Microfluidic Patches

Salts



Electrochemical Devices

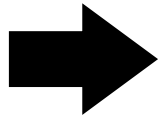
Glucose

POCT

DNA?

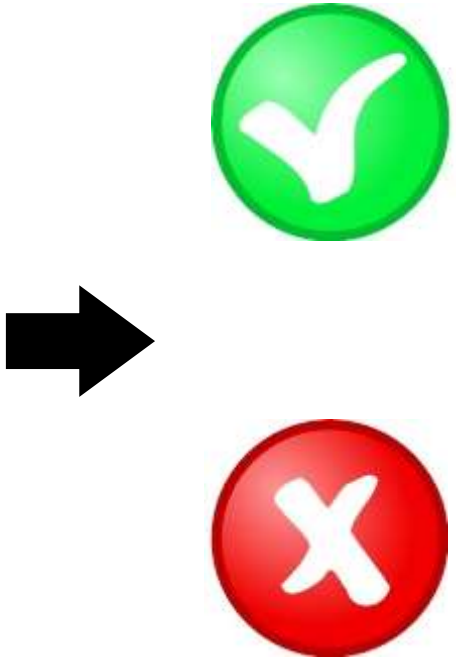
Science Advances 16 Feb 2018: Vol. 4, no. 2, eaar3921
ACS Sens., 2017, 2 (12), pp 1860–1868

Rapid DNA Analysis



Current DNA Lab

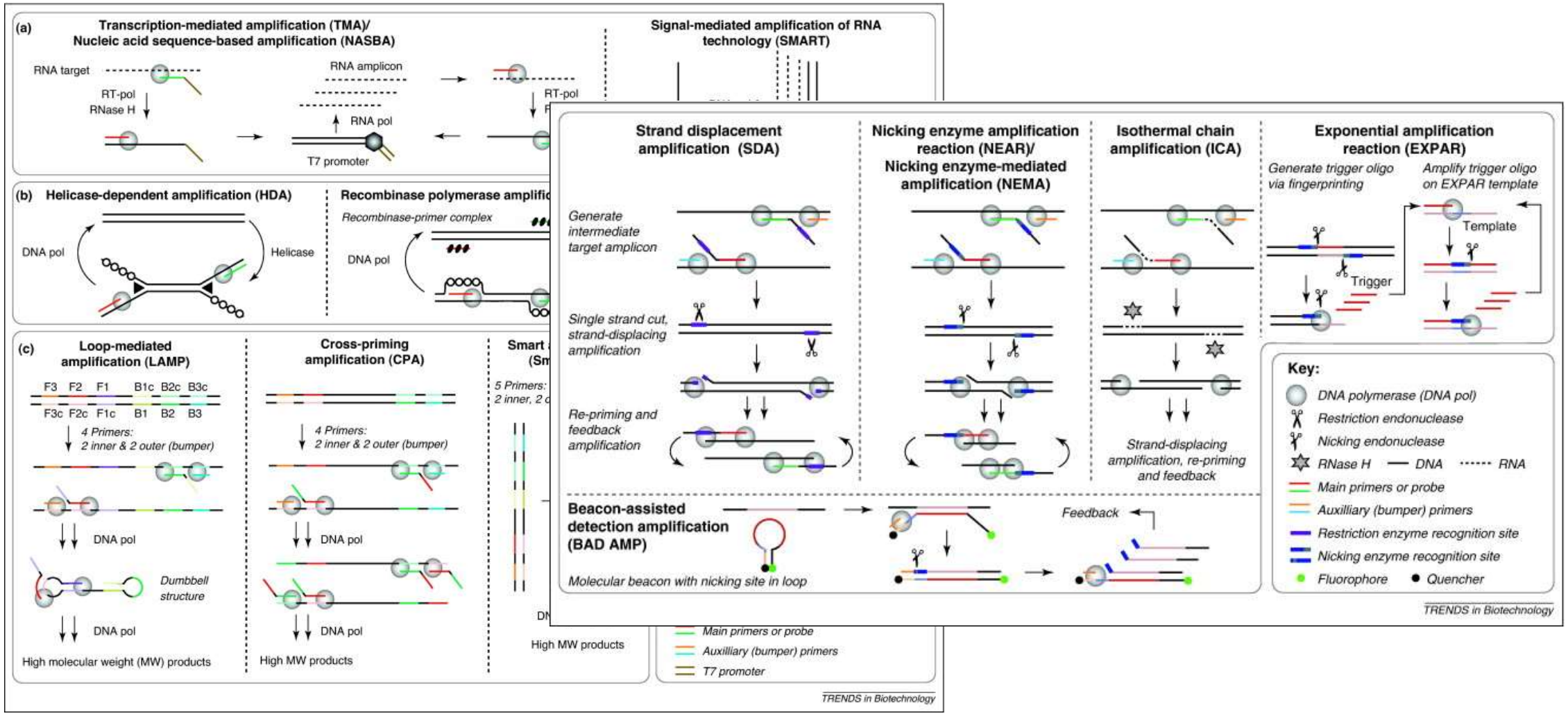
Rapid DNA Analysis



‘POC’ DNA ‘Lab’
(minutes)

Connolly *et.al.*, Angew Chem Int Ed Engl. 2010 Apr 1;49(15):2720

Rapid DNA Analysis

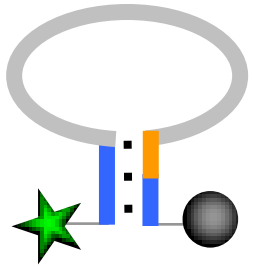


Boyle, D.,S., et. al. Trends in Biotechnology Volume 29, Issue 5, May 2011, Pages 240-250

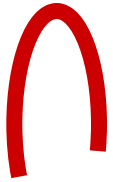
Rapid DNA Analysis

Molecular Switches

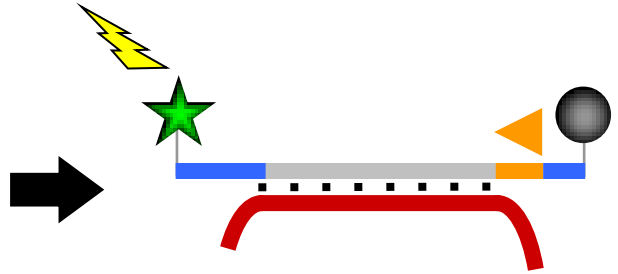
Conformation Change



\+



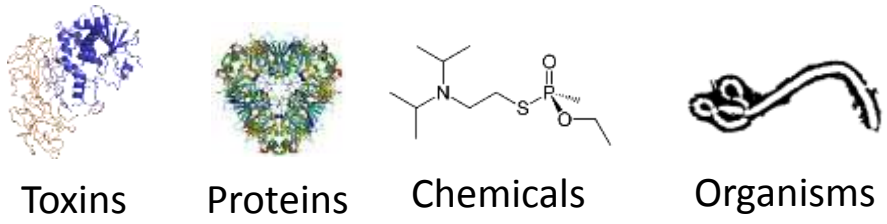
DNA

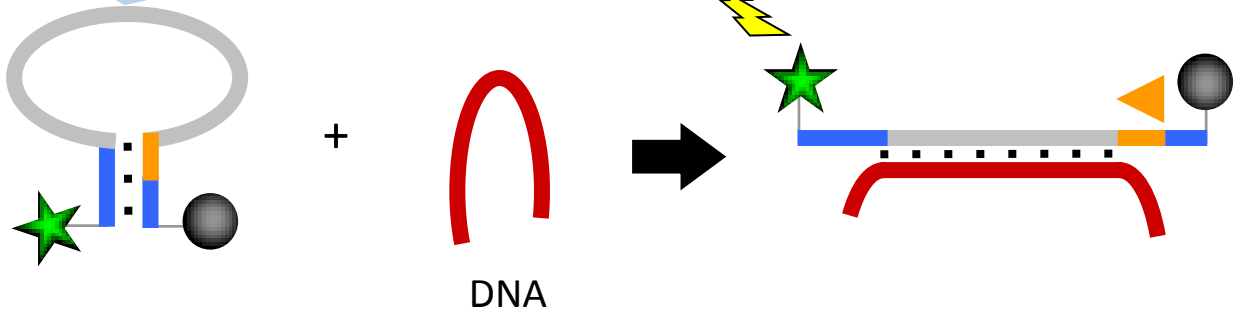


Rapid Analysis

Molecular Switches

Conformation Change



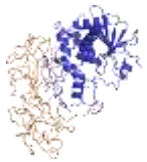


Smart Tissues

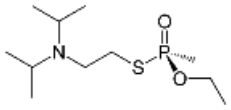
(Detect Genetic Material)

Smart Tissues

Smart Tissues

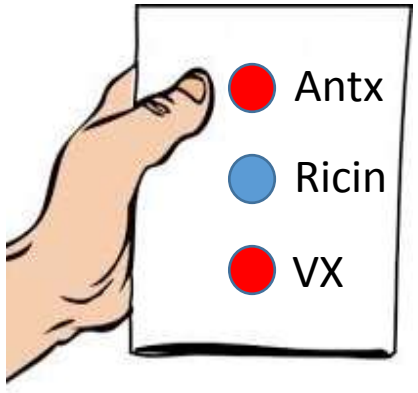

Toxins


Proteins



Chemicals

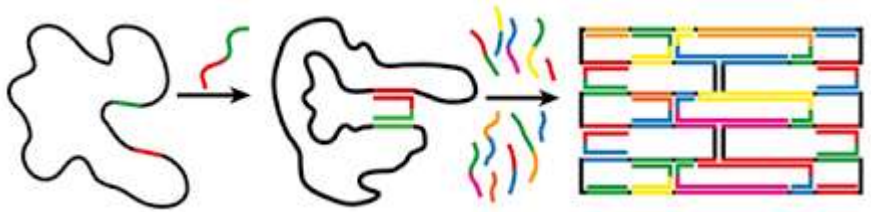

Organisms

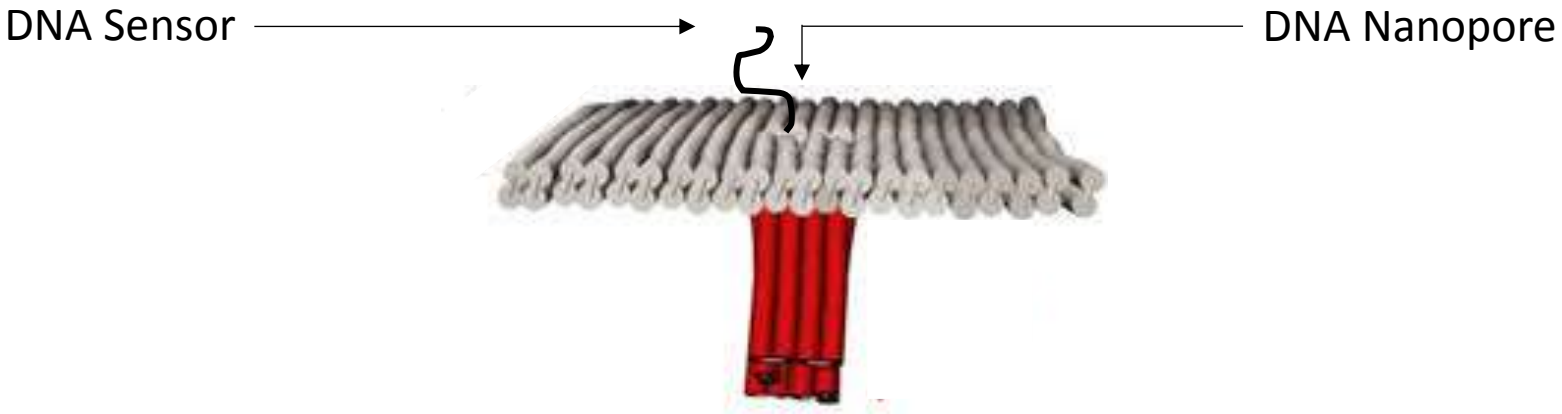


ATROPINE

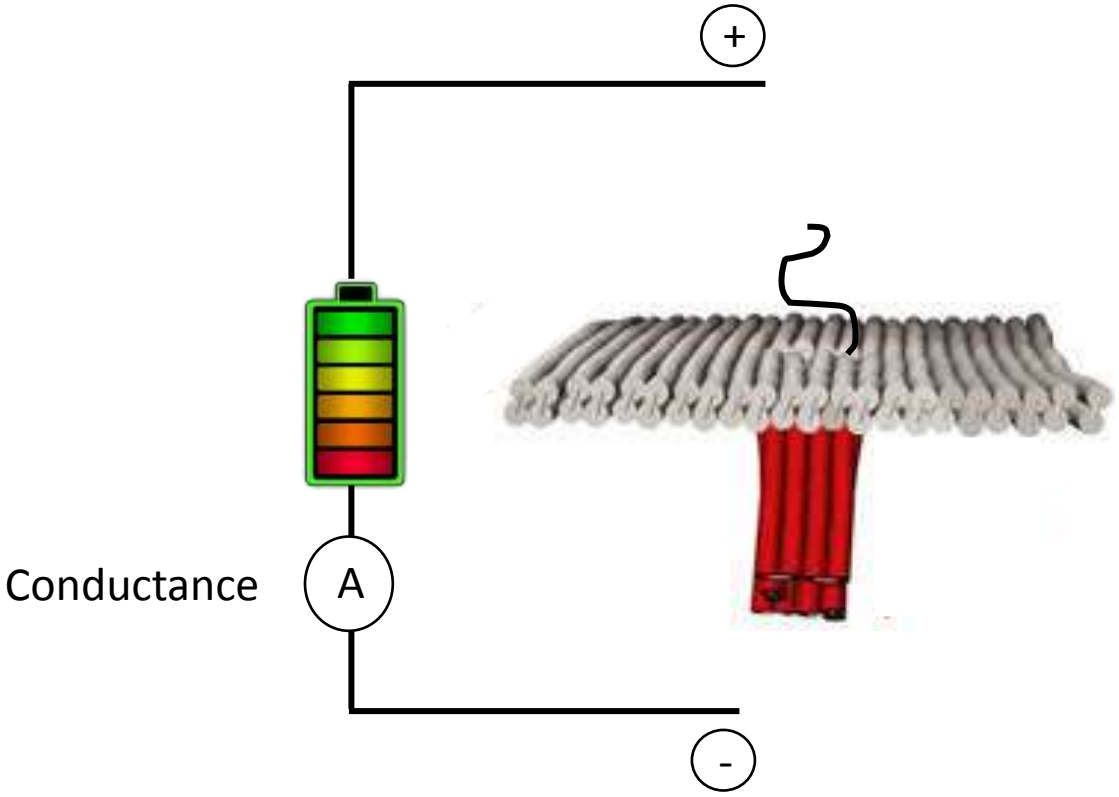
Concept 2
Nanopore Stickers

(single molecule detectors)



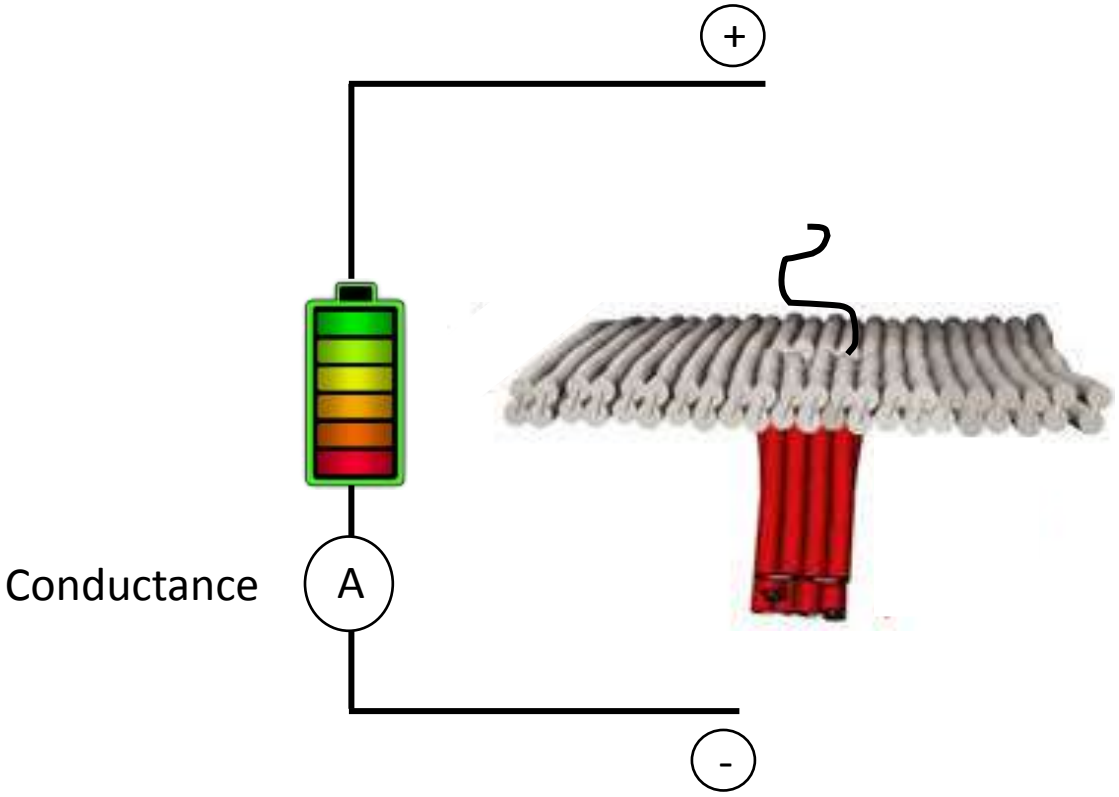


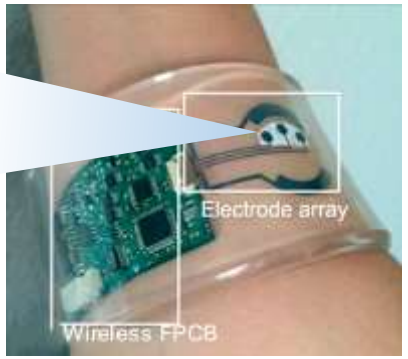
Nanopore Stickers



DNA nanopore Nature Communications **volume 7**, Article number: 12787 (2016)

Nanopore Stickers

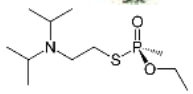




Single molecule Detection

Toxins

Proteins



Chemicals

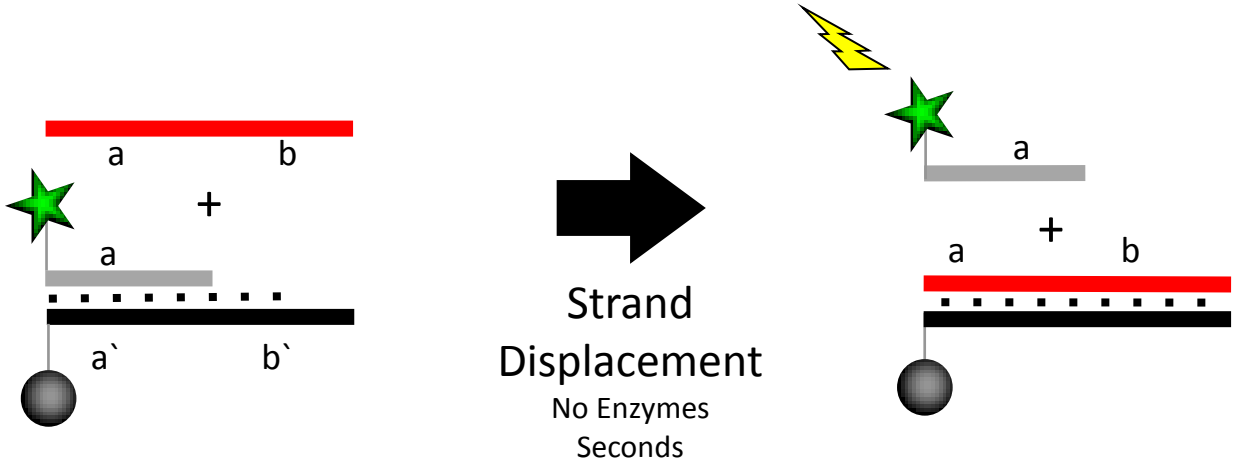
Organisms

Soldiers Health
Real Time

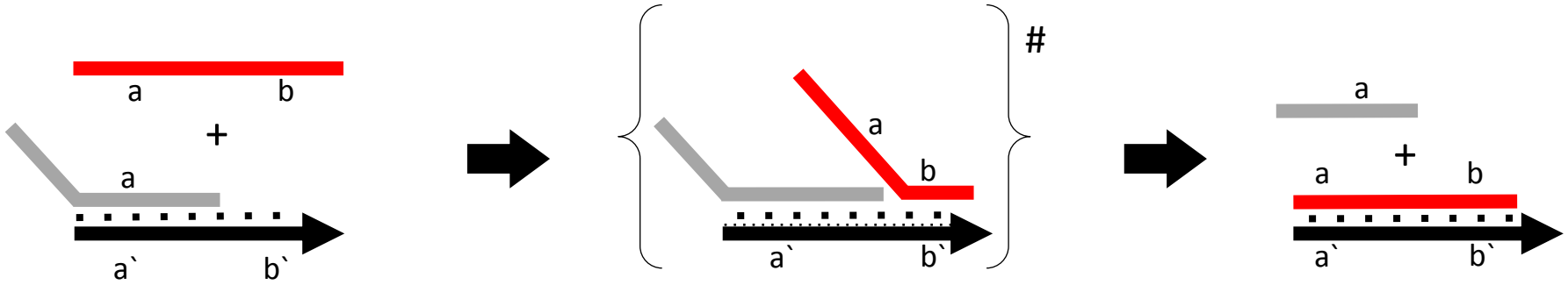
DNA nanopore Nature Communications **volume 7**, Article number: 12787 (2016)

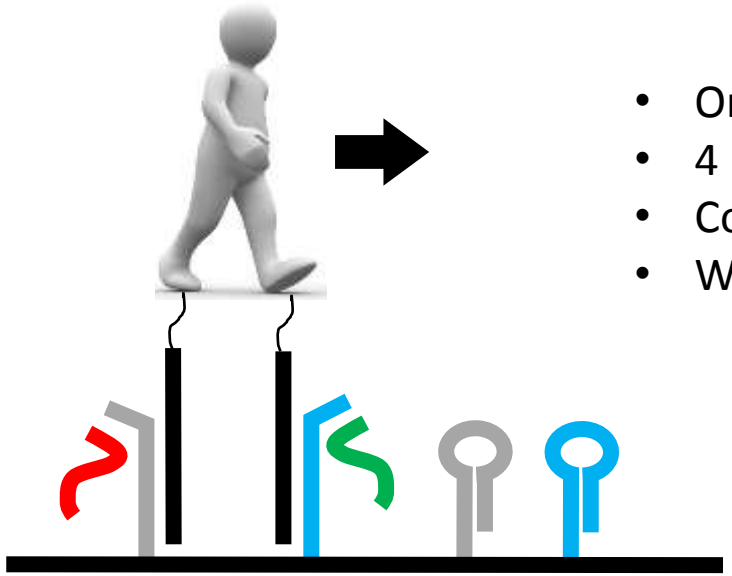
Concept 3
DNA Logic Devices

Molecular Switches



Logical DNA Devices





- One step = Unique SDA reaction
- 4 Leg DNA robots: START, MOVE TURN STOP
- Controlled by addition of ssDNA oligos
- Walk 100nm (~50 steps)

Yan, H. et.al., Nature. 2010 May 13; 465(7295): 206–210

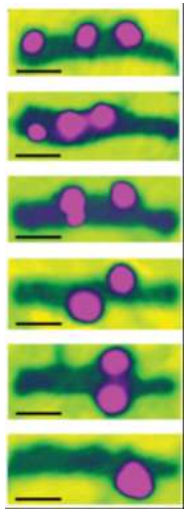
DNA Logic Devices

TRANSPORT

nature
LETTERS

A proximity-based programmable DNA nanoscale assembly line

Hongzhou Gu[1], Jie Chao[2], Shou-Jun Xiao[3] & Nadrian C. Seeman[1]



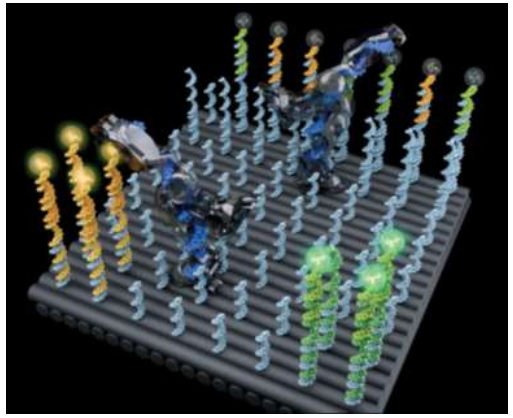
SORT

RESEARCH ARTICLE

DNA NANOTECHNOLOGY

A cargo-sorting DNA robot

Anupama J. Thubagere,[1] Wei Li,[1] Robert F. Johnson,[1] Zibo Chen,[1] Shayan Doroudi,[2] Yae Lim Lee,[3] Gregory Izatt,[2,4] Sarah Wittman,[2] Niranjan Srinivas,[4] Damien Woods,[2*] Erik Winfree,[1,2,4] Lulu Qian[1,2]†

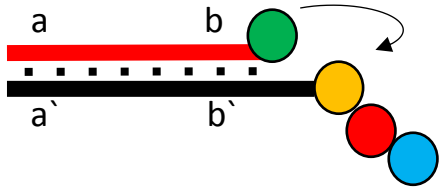


ASSEMBLE

ARTICLES
nature chemistry

An autonomous molecular assembler for programmable chemical synthesis

Wenjing Meng[†], Richard A. Muscat[†], Mireya L. McKee[†], Phillip J. Milnes[†], Afaf H. El-Sagheer[1,4], Jonathan Bath[†], Benjamin G. Davis[†], Tom Brown[†], Rachel K. O'Reilly[†] and Andrew J. Turberfield[†]*



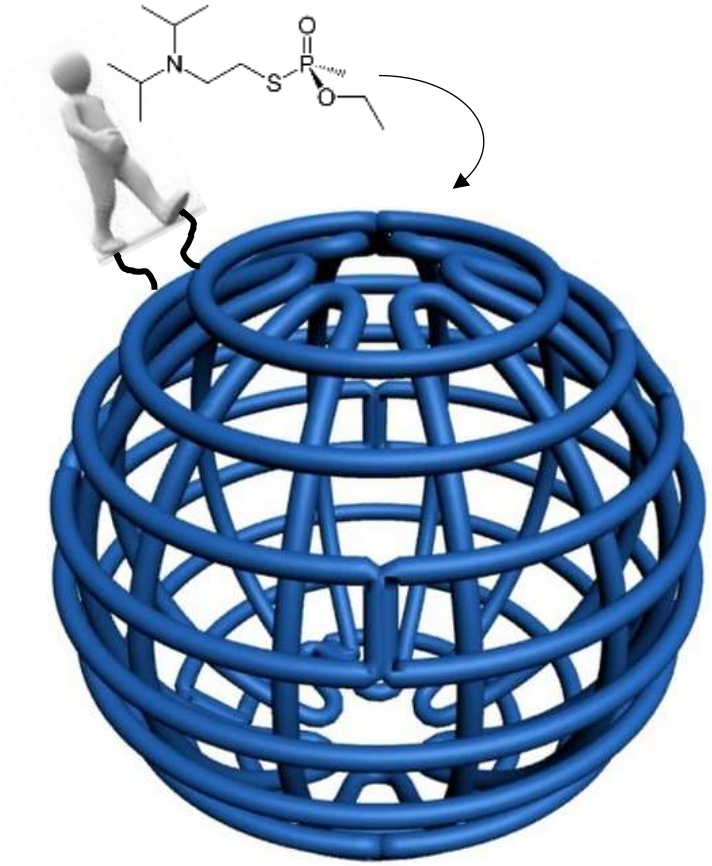
Seeman, N., *et.al.* Nature, 2010 Vol 465 13 May 202-6

Thubagere et al., Science 357, 1112 (2017) 15 September 2017

Turberfield, A.J. et. al. Nature Chemistry JUNE 2016. VOL 8. p542

Logical Pills

‘Pill’ of the Future
(Transport)

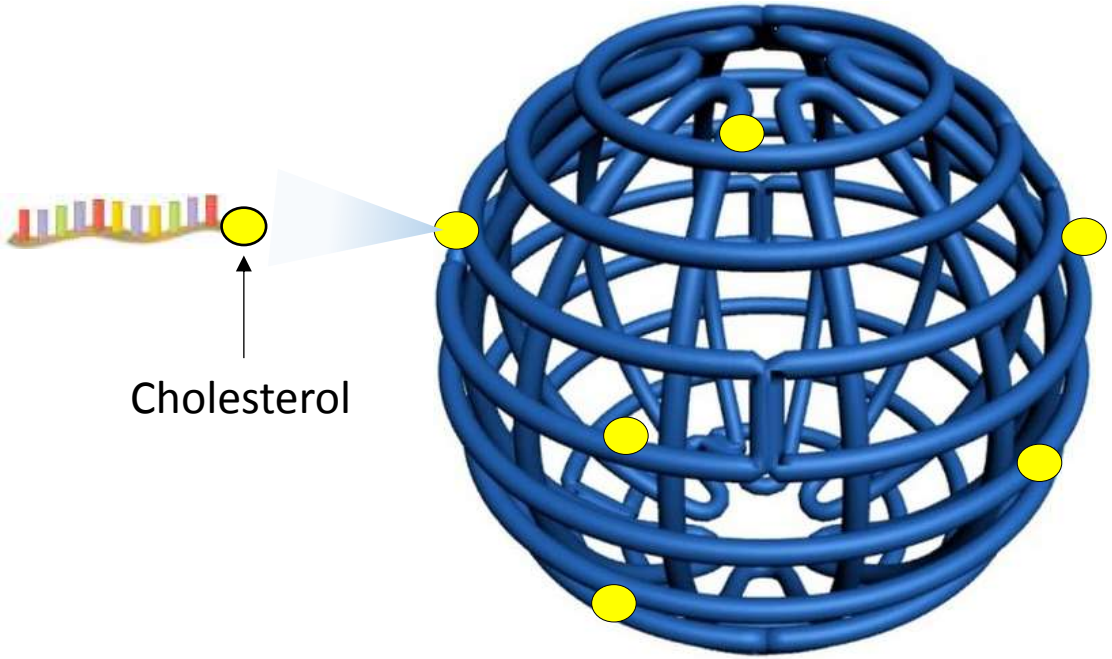


DNA Origami Sphere

- **Sequester**
- **Neutralise**

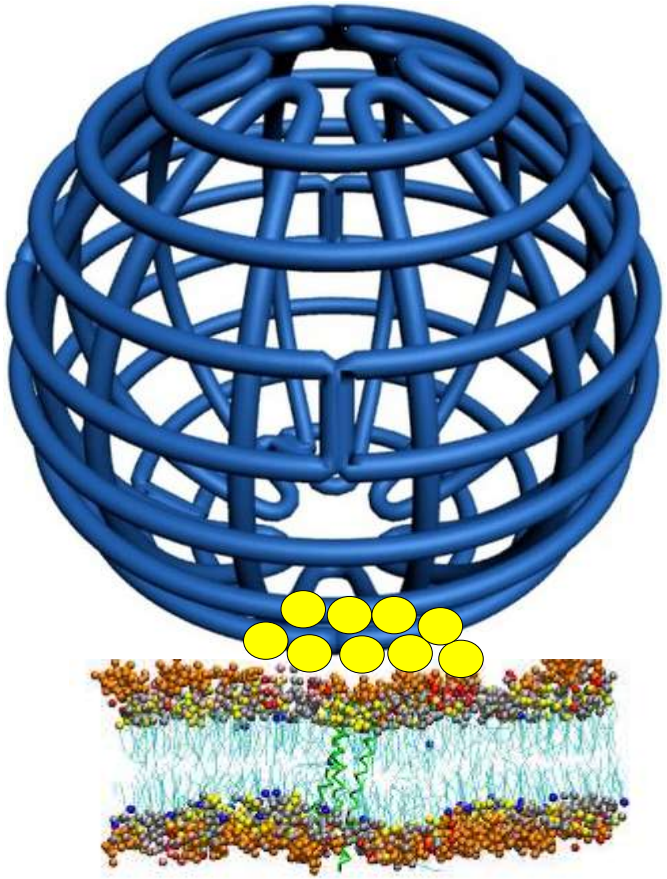
Logical Pills

‘Pill’ of the Future
(Sort)



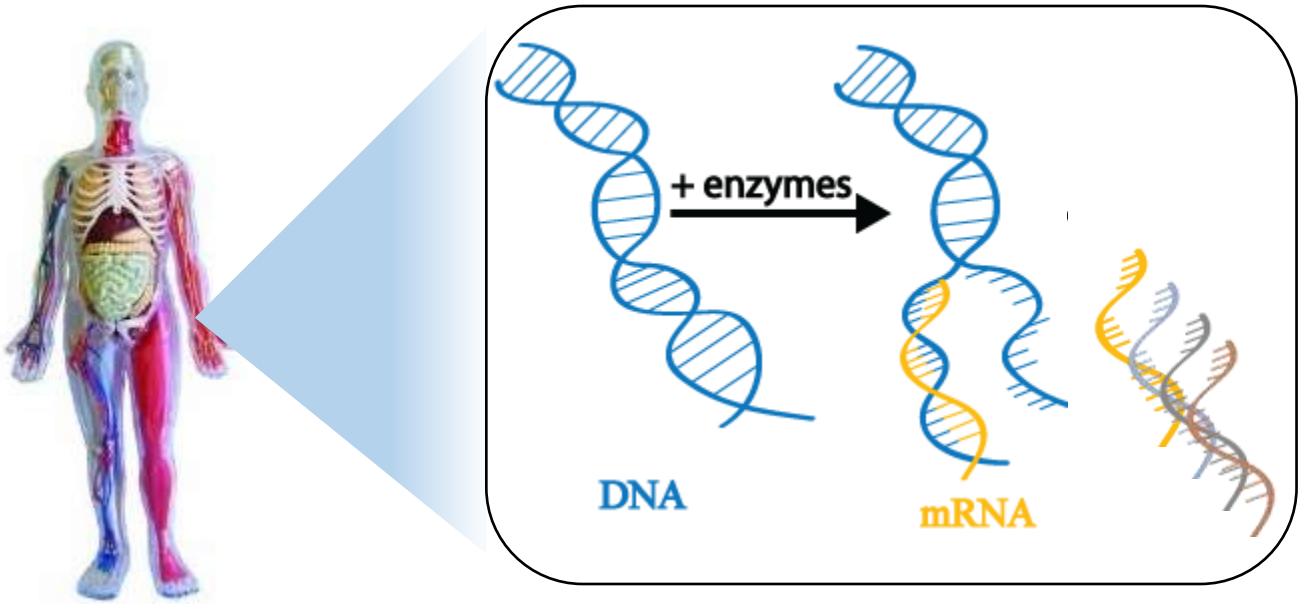
Cholesterol

DNA Origami Sphere

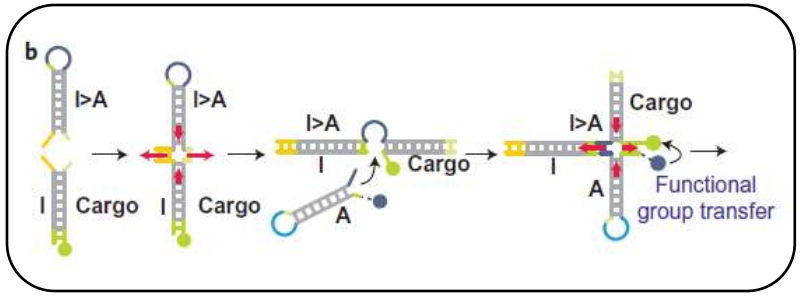


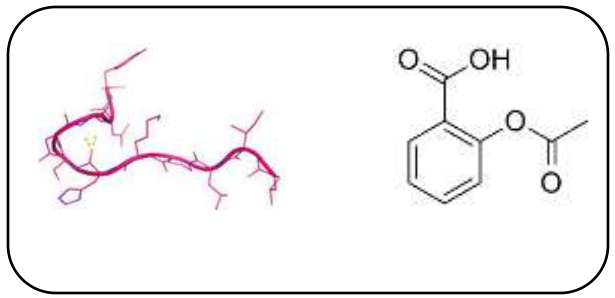
Cell membrane

Smart Drugs



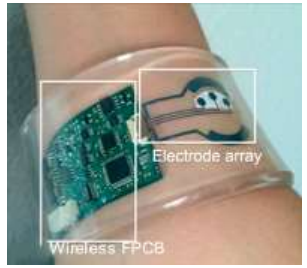
DNA Templated Synthesis

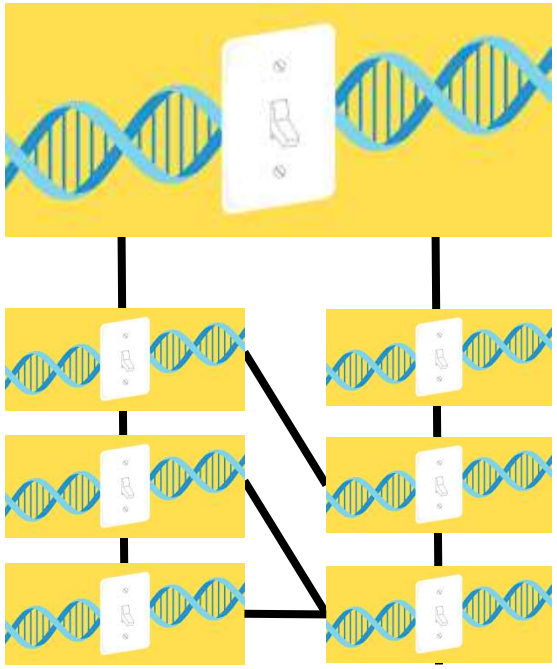




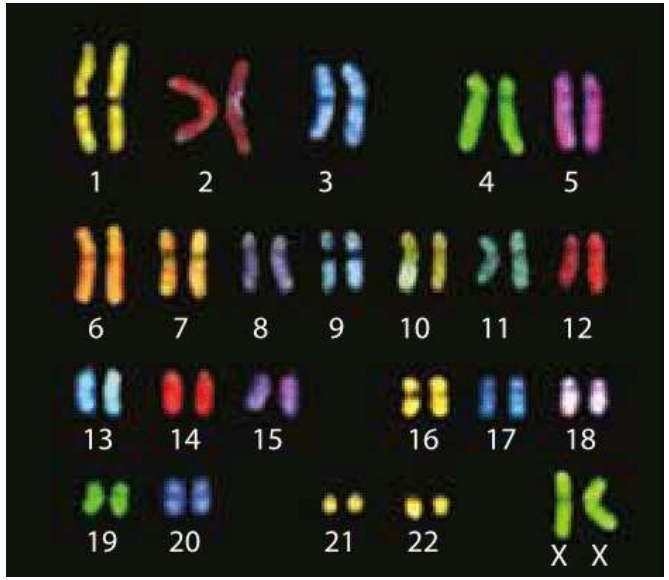
Tailored response

Summary





Integrate Switches



Integrate with
Genetic Homeostasis

INTELLIGENT DEVICES