

# INTERFACE FOCUS

[rsfs.royalsocietypublishing.org](http://rsfs.royalsocietypublishing.org)



**Cite this article:** Noble D, Kaminski C. 2015  
Introduction for bioinspiration. *Interface Focus*  
5: 20150052.

<http://dx.doi.org/10.1098/rsfs.2015.0052>

One contribution of 10 to a theme issue  
'Bioinspiration of new technologies'.

## Subject Areas:

biomimetics

## Author for correspondence:

Denis Noble

e-mail: [denis.noble@dpag.ox.ac.uk](mailto:denis.noble@dpag.ox.ac.uk)

 Invited to commemorate 350 years  
of scientific publishing at the Royal  
Society.

**THE ROYAL SOCIETY**  
PUBLISHING

## Introduction for bioinspiration

Denis Noble<sup>1,2</sup> and Clemens Kaminski<sup>3</sup>

<sup>1</sup>Editor, *Interface Focus*

<sup>2</sup>Department of Physiology, University of Oxford, Parks Road, Oxford, UK

<sup>3</sup>Department of Chemical Engineering and Biotechnology, University Cambridge, Pembroke Street, Cambridge, UK

The articles published in this issue of *Interface Focus* form a very special contribution to the celebrations during 2015 of the 350th anniversary of the first scientific journal, *Philosophical Transactions of the Royal Society*. We are delighted that the Society chose to publish the articles in one of the very newest journals of the Society. *Interface Focus*, similar to its parent journal *Interface*, echoes the original interdisciplinary nature of *Philosophical Transactions* before it was divided into the A and B series. We really do span across the whole breadth of physical and biological disciplines.

This issue on bioinspiration illustrates that breadth in examining the way in which the structures and functions of living organisms have inspired new forms of technology. Biological structures and processes have benefited from billions of years of refinement during the process of the evolution of life on Earth. So why should we not benefit from what nature discovered in designing our own new technologies? This meeting brought together scientists from a range of disciplines to discuss how nature has inspired their work and how this can contribute to the technological evolution.

The collection of papers begins with an engaging review by Whitesides [1] on the topic of *biomimetics*. He outlines clearly what is to be gained from mimicking nature's processes and materials, and that 'bioinspiration' spurs whole new branches of chemical research.

Deng & Almsherqi [2] look at a remarkable microbe that is able to survive in extreme environments, such as lack of food, thermal and osmolarity fluctuations, and high levels of reactive oxygen species. The way in which this is achieved through the 'crystallization' of the membrane into cubic structures provides clues to how phospholipids may not only facilitate these structural characteristics in such extreme conditions, but also provide a protective shelter for RNAs. It is not yet clear what insights this may provide for biotechnology, but it certainly provides insights into the evolution of life on Earth and how it survived harsh conditions.

In an article with the intriguing title 'Crystals: animal, vegetable or mineral?', Hyde [3] explores the evolution of our understanding of biomolecules that can assemble into aperiodic structures *in vivo*, so enabling us to understand structures across a wide spectrum of materials, from living to inanimate, with particular focus on the development of crystallography in materials science and biology.

Lagny & Bassereau [4] show how biologists have worked for a long time on deciphering how membranes are organized, and how they contribute to trafficking, motility, cytokinesis, cell-cell communication, information transport, etc., using top-down approaches and ever more advanced techniques. They ask and answer the question 'what can we still do with synthetic systems, where do we stop building-up and which are the alternative solutions?'

Cutkosky [5] shows how we can go in the reverse direction: from bioinspiration to biounderstanding, to show that the process of extracting principles from animals and adapting them to robots provides insights for both robotics and biology.

Schaber *et al.* [6] have contributed an article on modelling clustering of vertically aligned nanotube arrays (VACNT) to show how such modelling can inspire the adaption of VACNT arrays for biomimetic applications.

Patole *et al.* [7] take inspiration from photosynthetic systems in nature. Nanofabrication methods are described that lead to the self-assembly of light-harvesting proteins into patterned monolayers that may one day enable the storage of energy.

Hollfelder *et al.* [8] describes the use of small droplet compartments, generated in microfluidic devices, to mimic genetic evolution and how this bioinspired technology may lead to the discovery efficient molecular therapeutics.

Goldstein & van de Meent [9] consider 'life at small Reynolds numbers'. Fluid transport in nature's building blocks, cells, is almost universally governed by diffusion because of the small prevailing length scales. There are fascinating exceptions, however: he shows that convective phenomena

take place in certain giant cells types and that these may confer functional advantages.

The meeting at which the papers were presented was a great success. The oral presentations and discussions raised many new and exciting directions for research. The 350th anniversary celebrations offered a timely occasion for the Royal Society to explore a new ways of disseminating science to the wider world: the meeting was broadcast live and attended in satellite meetings in India and Brazil and there was active participation of online viewers during the discussion sessions. Recordings of every session can be viewed at <http://rsfs.royalsocietypublishing.org/content/bioinspiration-new-technologies>.

## References

- Whitesides GM. 2015 Bioinspiration: something for everyone. *Interface Focus* **5**, 20150031. (doi:10.1098/rsfs.2015.0031)
- Deng Y, Almsherqi ZA. 2015 Evolution of cubic membranes as antioxidant defence system. *Interface Focus* **5**, 20150012. (doi:10.1098/rsfs.2015.0012)
- Hyde ST. 2015 Crystals: animal, vegetable or mineral? *Interface Focus* **5**, 20150027. (doi:10.1098/rsfs.2015.0027)
- Lagny TJ, Bassereau P. 2015 Bioinspired membrane-based systems for a physical approach of cell organization and dynamics: usefulness and limitations. *Interface Focus* **5**, 20150038. (doi:10.1098/rsfs.2015.0038)
- Cutkosky MR. 2015 Climbing with adhesion: from bioinspiration to biounderstanding. *Interface Focus* **5**, 20150015. (doi:10.1098/rsfs.2015.0015)
- Schaber CF, Filippov AE, Heinlein T, Schneider JJ, Gorb SN. 2015 Modelling clustering of vertically aligned carbon nanotube arrays. *Interface Focus* **5**, 20150026. (doi:10.1098/rsfs.2015.0026)
- Patole S, Vasilev C, El-Zubir O, Wang L, Johnson MP, Cadby AJ, Leggett GJ, Hunter CN. 2015 Interference lithographic nanopatterning of plant and bacterial light-harvesting complexes on gold substrates. *Interface Focus* **5**, 20150005. (doi:10.1098/rsfs.2015.0005)
- van Vliet LD, Colin P-Y, Hollfelder F. 2015 Bioinspired genotype–phenotype linkages: mimicking cellular compartmentalization for the engineering of functional proteins. *Interface Focus* **5**, 20150035. (doi:10.1098/rsfs.2015.0035)
- Goldstein RE, van de Meent J-W. 2015 A physical perspective on cytoplasmic streaming. *Interface Focus* **5**, 20150030. (doi:10.1098/rsfs.2015.0030)