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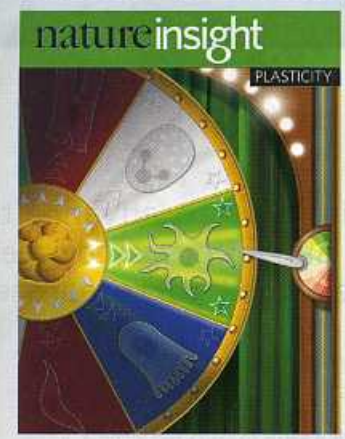
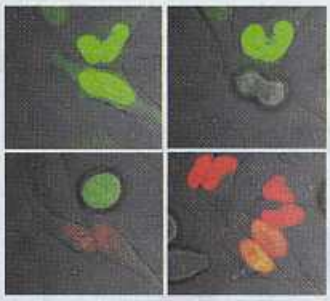


Plasticity is the capacity of cells or organisms to vary their properties or behaviour when environmental conditions change. Studies over the past few decades have shown that cells are considerably more plastic than had been thought. Uncovering the molecular and cellular mechanisms underlying this plasticity is a dynamic area of biology and biomedicine.



Technological advances allow researchers to follow dynamic changes in the fate of single cells, for example cell division, p. **736**. (Courtesy of D. Spiller and J. Ankers, Univ. Liverpool, UK.)

PLASTICITY

REVIEWS

704 Nuclear reprogramming to a pluripotent state by three approaches
S. Yamanaka & H. M. Blau
It was long thought that cells become committed to a particular lineage and are subsequently irreversibly fixed in a stable, differentiated state. Such stable states are now known to be dynamically regulated and easily perturbed. Three experimental approaches have been used to reprogram cells, inducing them to express genes typical of another cell type, particularly that of pluripotent cells (which can give rise to all cell types in the body). Depending on the approach used, researchers can gain insight into the molecular mechanisms involved at the onset of reprogramming, or can generate cells for modelling diseases or with the potential to replace or regenerate tissues.

713 Extrinsic regulation of pluripotent stem cells
M. F. Pera & P. P. L. Tam
During development, the pluripotent cells of the embryo become restricted in their developmental potential in a stepwise manner, which involves changes in the expression of key regulatory genes. Stem-cell lines with distinct phenotypes have been derived from mouse embryos, indicating that there is a developmental continuum of pluripotent states. Recent studies show that these cell lines are highly plastic, as well as heterogeneous, properties that are modulated by extrinsic signalling. Understanding how plasticity is controlled by such signalling is crucial if stem cells are to fulfil their therapeutic potential.

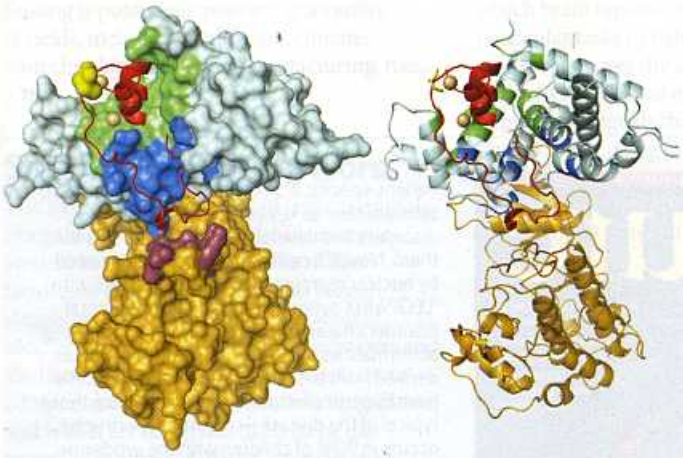
PERSPECTIVE

721 Epigenetics as a unifying principle in the aetiology of complex traits and diseases
A. Petronis
An organism's phenotype is a product of both its genes and its environment. Yet data from twin studies indicate that DNA sequence variation and environmental differences cannot account for all of the observed variation in complex traits and diseases. Now, it is proposed that epigenetic factors — which can be thought of as lying at the interface between the genes and the environment — have a central role in phenotypic variation. Epigenetic plasticity could be a core molecular mechanism underlying complex traits and diseases.

REVIEWS

728 Brain function and chromatin plasticity
C. Dulac
Chromatin modifications, such as DNA methylation and histone acetylation, have been associated with alterations in gene expression, with effects persisting well beyond the original modification event. Chromatin changes may maintain a 'memory trace' of transient signals, but the relevance of these traces for proper brain function is unclear. Several studies have found that chromatin modifications correlate with the long-term modulation of neuronal plasticity. Yet, with the mechanisms underlying these changes still largely undefined, it is unclear whether chromatin plasticity is essential for stably altering normal brain function or is simply part of the brain's complex transcriptional regulation program.

736 Measurement of single-cell dynamics
D. G. Spiller, C. D. Wood, D. A. Rand & M. R. H. White
Cells within a population do not respond uniformly to a particular signal, but this heterogeneity is not apparent when studying cellular and molecular processes at the population level. To understand plasticity, it is important to assess the changes occurring in single cells in a population. Such studies are becoming possible with the advent of new tools for manipulating single cells and for measuring cell-fate decisions, such as differentiation, cell division and cell death, in individual cells. The challenge remains to design experimental and computational methods that can integrate the complex data obtained from these studies.



Antiviral target: HIV Tat protein in complex with host P-TEFb, p. **747**.

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ADVANCE ONLINE PUBLICATION

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Termination of autophagy and reformation of lysosomes regulated by mTOR
L Yu, C K McPhee, L Zheng, G A Mardones, Y Rong, J Peng, N Mi, Y Zhao, Z Liu, F Wan, D W Hailey, V Oorschot, J Klumperman, E H Baehrecke & M J Lenardo doi:10.1038/nature09076

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The genome-wide structure of the Jewish people
D M Behar, B Yunusbayev, M Metspalu, E Metspalu, S Rosset, J Parik, S Rootsi, G Chaubey, I Kutuev, G Yudkovsky, E K Khusnutdinova, O Balanovsky, O Semino, L Pereira, D Comas, D Gurwitz, B Bonne-Tamir, T Parfitt, M F Hammer, K Skorecki & R Villems doi:10.1038/nature09103

Functional impact of global rare copy number variation in autism spectrum disorders
D Pinto *et al.* doi:10.1038/nature09146

Environmental context explains Lévy and Brownian movement patterns of marine predators
N E Humphries, N Queiroz, J R M Dyer, N G Pade, M K Musyl, K M Schaefer, D W Fuller, J M Brunnschweiler, T K Doyle, J D R Houghton, G C Hays, C S Jones, L R Noble, V J Wearmouth, E J Southall & D W Sims
doi:10.1038/nature09116

THIS WEEK'S PODCAST

Published online on 9 June, a comparison of genomic data from 14 Jewish communities across the world with data from non-Jewish populations provides a new window on the demographic history of Jewish people. More on the podcast. Also featured this week, coping with climate change 'doubt-mongers', reflections on whether investment in research yields economic dividends and attosecond imaging of hydrogen.
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