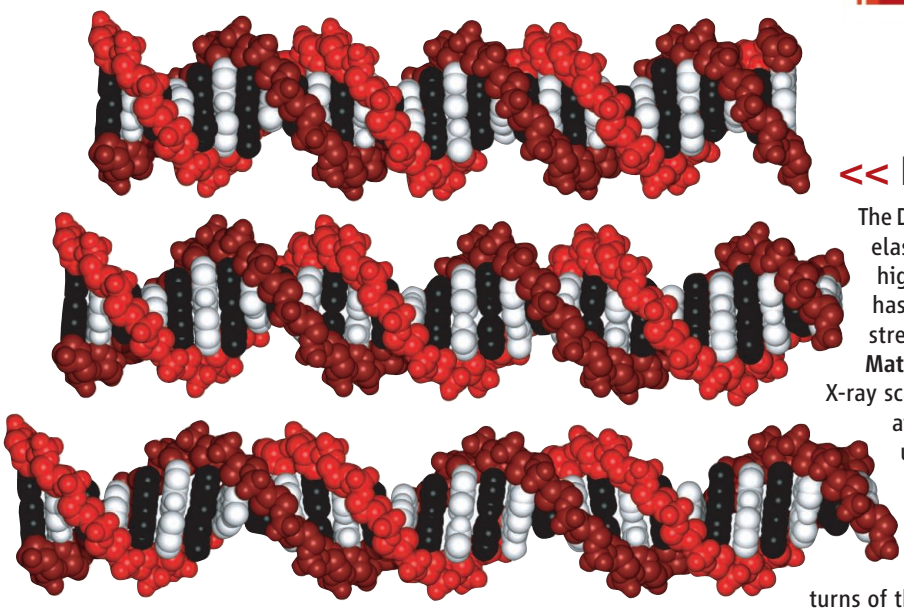
EDITED BY STELLA HURTLEY



<< Flexing the Double Helix

The DNA duplex at equilibrium is generally viewed as an elastic rod. Recent experimental observations have highlighted that this is an oversimplification, but it has been difficult to resolve bending, twisting, and stretching fluctuations at a microscopic level. Now **Matthew-Fenn *et al.*** (p. 446) have used small-angle X-ray scattering interference between gold nanocrystals attached to the ends of DNA double helices to measure directly the distance distributions of DNA fragments short enough to limit bending. The results show that stretching fluctuations are much larger than expected for an ideal elastic rod and that stretching is correlated over at least two turns of the double helix. This correlated stretching could allow for allosteric communication along the DNA structure.

Riding the Spin-Wave

Much work is being undertaken that uses the spin property of electrons rather than, or as well as, its charge. Spin density waves are excitations of polarized electrons that propagate through magnetic systems. Determining the spin properties in a circuit, however, is a challenge. **Vlaminck and Bailleul** (p. 410; see the Perspective by **McMichael and Stiles**) demonstrate a long-proposed effect in which an injected current should result in the frequency-shift (or Doppler shift) of the propagating spin waves. Such a simple technique should prove invaluable in the development of spintronics.

Double Cosmic Rubble

About 70 small binary asteroids have been found in which two small bodies orbit each other. Many of these binary asteroids are weak objects composed of rubble held together by their weak gravity, and it has been suggested that some may have formed by the disruption of a single object. **Petit *et al.*** (p. 432) have now tracked one enigmatic binary in the Kuiper Belt, beyond Pluto, and show that its pairs are orbiting in an eccentric orbit more than 100,000 km apart. This great distance, 2000 times their radii, is difficult to create and maintain against disruption from the gravitation attraction of other objects. It is thus most likely that it formed from a collision, and its fragile existence could imply that such bodies would have been more common early in the solar system.

Fuel from Sorbitol

The chemical infrastructure for converting crude petroleum into fuel and functional compounds relies largely on breaking down and oxidizing long hydrocarbons. In contrast, a switch to carbohydrate biomass as the basic feedstock requires processing a set of very different building blocks that come excessively oxygenated. **Kunkes *et al.*** (p. 417, published online 18 September) present a two-stage strategy for converting abundant sugars such as glucose and sorbitol into fuels and commodity chemicals. In an initial reactor, a platinum-rhenium catalyst breaks down the aqueous sugar feed into alcohol and carbonyl compounds. The product can then be directed into a second reactor for catenation of these intermediates into chains, with an array of different catalysts available to select for either the highly branched structure of gasoline, or the longer-chain, more linear geometry used in Diesel and jet fuel mixtures.

Regulating Gene Regulation

Tissue-specific gene expression is established by sets of highly conserved transcription factors, common throughout mammals. However, the transcription factor binding sites themselves have changed dramatically during evolution. These changes could be the result of a variety of factors, including epigenetics, chromatin structure, underlying sequence changes, environment, and diet. To sort out the environmental versus genetic factors controlling gene expression, **Wilson *et al.*** (p. 434, published online 11 September; see the Perspective by **Coller and Kruglyak**) studied expression in the liver of mice that stably transmit a copy of human chromosome 21. This made it possible to study transcriptional regulation of complete homologous chromosomes of human and mouse sequences simultaneously in the same nuclei. In terms of protein-DNA binding, histone methylation, and transcription in vivo, DNA sequence was a more important determinant than the environment.

Imaging Internal Temperatures

Temperature is normally measured locally at the surface of a sample but, in many clinical situations, it would be useful to obtain temperature profiles inside the tissue, for example, during hyperthermic therapy. Such profiles can be obtained with contrast agents in conventional magnetic resonance imaging but drawbacks can arise from inhomogeneities in the magnetic fields as they pass through the body or from the technique's inability to work well in fatty tissue, such as the breast. **Galiana *et al.*** (p. 421) have developed a method that allows the temperature-dependent chemical shift of water to be measured relative to the temperature-independent chemical shift of lipids by using long-range intermolecular zero- and double-quantum coherences. The authors use their method to produce temperature profiles across the body of a living mouse.

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CREDITS (TOP TO BOTTOM): MATTHEW-FENN *ET AL.*; GALIANA *ET AL.*

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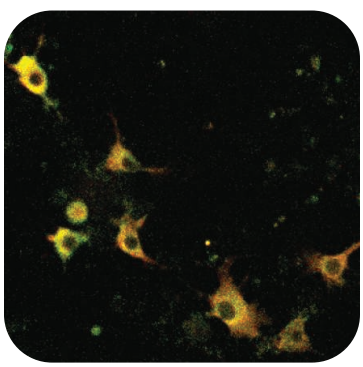
Ordered Solution

Block copolymers consisting of two chemically dissimilar covalently connected polymers will spontaneously phase separate into arrays of spheres or cylinders, depending on the concentration of the two blocks. With dissolution of one of the components, the materials can be used for templating semiconductor materials, for example, in the fabrication of memory chips. However, while the semiconductor industry is used to working with rectilinear patterns, the ordering of the spheres or cylinders tends to be hexagonal. **Tang *et al.*** (p. 429, published online 25 September) engineered two block copolymers to induce hydrogen bonding between the polystyrene blocks in each of them. When mixed, the polymers generated well-defined patterns with square symmetry.

Stochastic Changes

Cells that are genetically identical and in the same environment can display different phenotypes with a single cell switching stochastically between the phenotypes. A classic example is lactose metabolism in *Escherichia coli*—at intermediate inducer concentrations a fraction of cells in a population display an induced phenotype. **Choi *et al.*** (p. 442) examined the molecular basis of this switching by directly monitoring the expression of *lac* genes at a single molecule level. The tetrameric *lac* repressor, which binds to two operators on looped DNA, frequently dissociates from one operator to give basal level expression. Infrequently, there is complete dissociation from both operators to give large bursts of expression that trigger full induction. Thus, a stochastic molecular event acts to switch individual cells from an uninduced to an induced phenotype.



CREDIT: BAKAL *ET AL.*

Mapping Out Redundancy

Living organisms often have compensatory signaling mechanisms that allow the loss of function of a single component to be tolerated, even in important regulatory pathways. This makes such pathways robust to potential challenges, but makes the job of unraveling and mapping the pathways more difficult. To work around such buffering or functional redundancy, **Bakal *et al.*** (p. 453) systematically tested more than 16,000 RNAi combinations in *Drosophila* tissue culture cells in order to identify regulators of *Drosophila* Jun NH_2-terminal Kinase (JNK). Further analysis with phosphoproteomic data and computational models of kinase specificity was used to establish where the components identified fit in a regulatory network. Similar approaches should help to unravel other critical targets for therapeutic modulation of cell function.

Genes and Weight Gain

What are the factors that increase an individual's risk of future weight gain? It has been hypothesized that obese individuals may have an underactive reward circuitry, which leads them to overeat in an effort to boost a sluggish dopamine reward system. Using brain imaging, **Stice *et al.*** (p. 449; cover) discovered a relationship between activation of the striatum and ingestion of a tasty calorific liquid compared with a neutral liquid that could differentiate between obese and non-obese individuals. This differential activation was accentuated in individuals bearing the A1 allele of the dopamine D2 receptor gene, which is associated with reduced dopamine transmission in the striatum. This relationship predicted an individual's weight gain when measured a year later.

Nematode Immune Defenses

Like all of us, the nematode worm, *Caenorhadbditis elegans*, is susceptible to illness and infection caused by bacteria. And, like all of us, worms mount an immune defense against infection. **Styer *et al.*** (p. 460, published online 18 September) now present data that suggest that the innate immune response of *C. elegans* requires expression of a G protein–coupled receptor, npr-1, in sensory neurons. The response also requires other signaling-related molecules, a cyclic GMP–gated ion channel and a soluble guanylate cyclase. The sensory neurons act to control the immune response throughout the worm. Thus, these neurons seem to control innate immunity in *C. elegans* by receiving signals from pathogens and then initiating an organism-wide immune response.

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