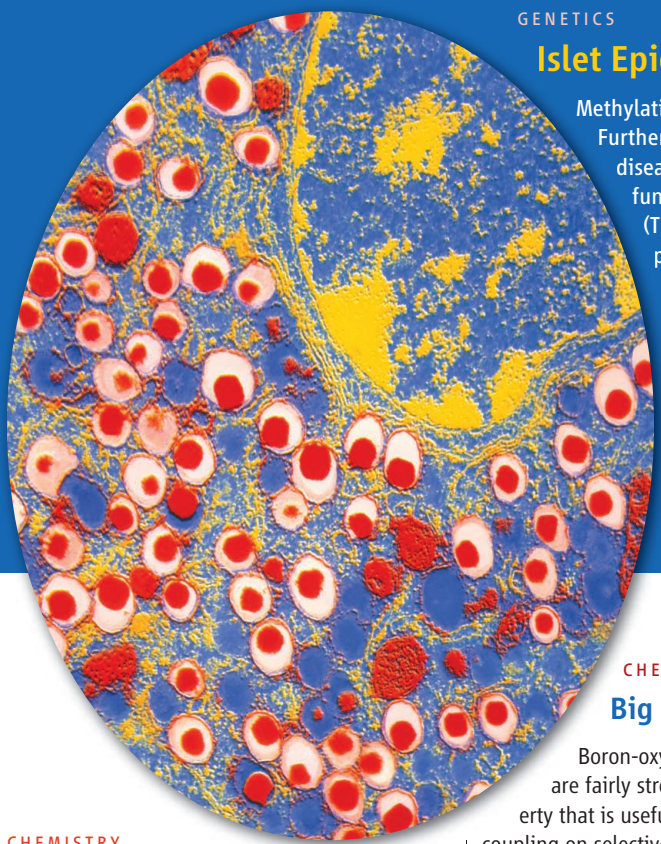
EDITED BY KRISTEN MUELLER AND JESSE SMITH



GENETICS

Islet Epigenetics

Methylation is a form of epigenetic regulation that can influence gene expression. Furthermore, methylation has been postulated to underlie some complex traits and diseases, especially those for which genetic factors have been poorly identified or functionally understood. In order to investigate the epigenetics of type 2 diabetes (T2D), Dayeh *et al.* examined the genome-wide DNA methylation patterns in pancreatic islets in both diabetics and nondiabetics. They found that the degree of methylation was correlated with transcription, although overall levels of methylation did not differ between diabetics and nondiabetics. Differentially methylated regions between individuals with and without T2D were identified. Of the more than 800 genes exhibiting differential methylation, 102 showed differential mRNA expression, including 17 candidate T2D genes expressed in islets. Furthermore, functional analyses provided support that these observed methylation differences may underlie differences in gene expression and potentially link the complex phenotype of T2D with epigenetic modifications. — LMZ

PLOS Genet. **10**, e1004160 (2014).

CHEMISTRY

Printable Hydrogels

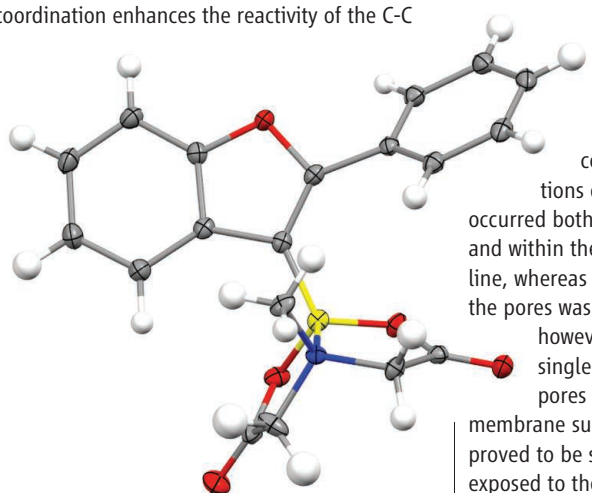
Hydrogels consist of highly water-swollen cross-linked polymer networks, which make them of interest as materials for storing and delivering cells. However, because they are soft and squishy, it is difficult to shape or form the hydrogels in the way that you might construct pieces from more solid materials. One hydrogel system used for tissue engineering is based on gelatine, a low-immune-response, enzymatically degradable protein, which is cross-linked with methacryalmide groups. Through the addition of gellan gum, an FDA-approved food additive, Melchels *et al.* show that the gelatin-methacrylamide can be made stiff enough to be used in additive printing processes for making complex shapes. The chains in gellan gum bind through ionic bonding, so by adjusting the salt concentration, it is possible to tune the rheological properties to allow for shear thinning and yield stress, which are necessary for depositing material at controlled places. The salt concentrations, however, were lower than those found in physiological conditions, so the authors replaced some of the phosphate-buffered saline with the sugar mannose to provide a controlled osmotic-pressure environment to allow for the inclusion of cells within the gel material. — MSL

J. Mater. Chem. B 10.1039/c3tb21280g (2014).

CHEMISTRY

Big Break for Boron

Boron-oxygen (B-O) bonds generally are fairly strong and unreactive, a property that is useful in the reliance of Suzuki coupling on selective reactivity of the B-C bonds in boronate esters. Hirner *et al.* have devised a catalyst that formally cleaves B-O bonds through their intramolecular addition across an alkyne. Reasoning that direct insertion of a metal into the bond would face too high an energy barrier, the authors implemented a dual activation strategy, targeting a mechanism in which gold coordination enhances the reactivity of the C-C



triple bond while trifluoroacetate coordination to B stimulates transfer of the adjacent O group. The protocol furnished a diverse array of benzofuran products with a B substituent conveniently poised for further reactivity via Suzuki coupling or other elaborations. Moreover, the reaction is broadly tolerant of groups such as halogens, esters, and nitriles, and it manifests complementary site-selectivity to arene C-H borylation reactions. — JSY

J. Am. Chem. Soc. **135**, 10.1021/ja500463p (2014).

MATERIALS SCIENCE

Confined Stability

Of the three polymorphs of calcium carbonate, vaterite is less stable than either calcite or aragonite and is difficult to obtain in single-crystal form without the use of additives. It is generally not seen in geologic materials, but there are a few cases where it appears as a biomineral. Schenk *et al.* synthesized $CaCO_3$ crystals inside track-etched coated polycarbonate membranes under a range of conditions. Under high concentrations of Ca^{2+}, precipitation of vaterite occurred both on the surface of the membranes and within the pores, but it was polycrystalline, whereas at low Ca^{2+}, little infiltration of the pores was observed. At intermediate values, however, the authors observed primarily single-crystal rods of vaterite within the pores and predominately calcite on the membrane surfaces. The vaterite crystals also proved to be stable for several days, even when exposed to the reaction solutions. The results are somewhat complicated, because vaterite crystallization was not observed in the pores of similarly treated membranes from a different supplier. The authors speculate that there probably are subtle differences in the microenviroments of the pores in the two different membranes

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and, in particular, that the vaterite- growing membranes possess a surface coating that better collects and organizes the Ca^{2+} ions, thus stabilizing the formation of vaterite. — MSL

Chem. Commun. 10.1039/C4CC01093K (2014).

ECOLOGY

Data Driven Decision-Making

A combination of remote sensing and ecological modeling can increase the efficacy of the reintroduction of endangered plant species, a study in a Hawaiian dryland habitat shows. Reintroductions and habitat restoration are important components of conservation, but with often-limited resources, it can be important to maximize the chances of success. Questad *et al*. used LiDAR (airborne light detection and ranging) data to determine the optimum topographic features. LiDAR enables mapping of topography at a scale that is relevant to the establishment of individual plants — in this case the shrub *Dodonaea viscosa* and its associated native plant species. The topographic mapping was used to model the optimization of water and nutrient availability and hence to determine

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sites that were most promising for restoration. Experimental plantings showed better establishment and growth in the sites that LiDAR identified as suitable. This suite of techniques indicates promise for restoring vegetation and species of conservation concern in a wider range of degraded and disturbed habitats. — AMS

Ecol. Appl. **24**, 385 (2014).

BIOMEDICINE

Rheumatoid Rescue?

MHC class II molecules can rescue endoplasmic reticulum–localized misfolded proteins from protein degradation and transport them to the cell surface intact by associating with the misfolded protein. MHC class II allelic polymorphisms are associated with susceptibility to many autoimmune diseases. Jin *et al.* have now found that cellular misfolded autoantigens rescued and complexed with MHC class II molecules can become targets for autoantibodies in patients with rheumatoid arthritis (RA). By analyzing sera from some RA patients in which autoantibodies against correctly folded intact proteins were not detectable, autoantibodies specific to misfolded proteins complexed with MHC class II molecules of disease-susceptible alleles but not disease-resistant MHC class II alleles were observed. This suggested that misfolded proteins complexed with MHC class II molecules are natural autoantigens for autoantibodies. Autoantibody binding to misfolded proteins transported by MHC class II molecules was strongly correlated with susceptibility to RA. Thus, misfolded proteins, which normally would not be exposed to the immune system, can be targets for autoantibodies when they avoid protein degradation. — SMH

Proc. Natl. Acad. Sci. U.S.A. **111**, 3787 (2014).

GENETICS

Regulating DNA Repair

Chromosomes carry the intricate code that makes and organizes cells and organisms. But chromosomes can break, causing a serious potential threat to cell and organismal survival. Repairing such breaks is vital, but repair can come with its own dangers, as certain repair pathways are necessarily error-prone—restoring chromosome integrity at the cost of introducing mutations into the genome. Microhomology-mediated end joining (MMEJ) is an error-prone form of repair that relies on very small (~5 to 25 base pairs) fortuitous homologies near the broken ends of chromosomes, which allow them to come together and be rejoined. A microhomology signature is often seen in breakpoints in chromosome arrangements in cancers and other diseases, suggesting that MMEJ is commonly involved in such genome derangement. Deng *et al.* investigated MMEJ in the budding yeast *Saccharomyces cerevisiae*. They find that although resection [the trimming back of one of the DNA stands to generate a single-stranded DNA (ssDNA) tail] at the ends of the breaks is important to expose regions of microhomology internal to the break, it is not rate-limiting for repair. On the other hand, replication protein A, which binds ssDNA, actively prevents spontaneous annealing between the microhomologies and suppresses MMEJ. — GR

Nat. Struct. Mol. Biol. 10.1038/nsmb.2786 (2014).

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