IMMUNOTHERAPY

Engineering T cells to treat autoimmunity

Autoimmune diseases such as lupus and rheumatoid arthritis lack therapies that specifically target only the disease-causing cells. Inspired by the clinical success of using chimeric antigen receptor T cells to treat certain types of cancers, Ellebrecht et al. asked whether a similar approach might also work against antibody-driven autoimmune diseases. They engineered T cells to express chimeric receptors consisting of the disease-causing autoantigen desmoglein 3 fused to signaling domains that activate T cells. When given to diseased mice, the engineered T cells targeted and killed B cells that express antibodies targeting desmoglein 3, hinting that such a strategy may be an effective way to treat antibody-driven autoimmune diseases. —KLM

Science, this issue p. 166

PLANT SCIENCE

Location, location, S-acylation

Cellulose synthase is a large, multisubunit machine that “swims” along the plant cell membrane as it spins out cellulose fibers. Kumar et al. show that the cellulose synthase complex is heavily modified through S-acylation. Subsets of the acylation sites were required for the complex to integrate into the plasma membrane. A single functional complex could bear as many as 100 modification sites, potentially changing its biophysical characteristics and helping it to associate with the membrane. —PJH

Science, this issue p. 179

BONE

Cartilage claims a permanent home

It is unclear whether certain tissues in our bodies are permanent or refreshed over time. Nuclear bomb testing more than 50 years ago released the carbon-14 isotope into the atmosphere, which allows researchers to determine the turnover of human tissues in people over 50 years old. Heinemeier et al. used this “C bomb pulse” method to determine the regenerative potential of cartilage. They examined human knee joints in both healthy individuals and those with osteoarthritis, taking cartilage samples from both high- and moderate-load areas. The collagen matrix of cartilage was essentially permanent, even in disease. Thus, tissue engineering and regenerative medicine need to take this structural stability of collagen into account when designing cartilage repair strategies. —MLF


NEUROPHYSIOLOGY

Going with the flow

The interstitial spaces of the brain are filled with cerebrospinal fluid (CSF). Faubel et al. studied fluid transport in the third ventricle of the brain of mice, rats, and pigs. Sophisticated, state-of-the-art fluid dynamic studies revealed a complex pattern of cilia beating that leads to an intricate network of “highways” of CSF flow. This flow rapidly and efficiently transports and partitions CSF. —SMH

Science, this issue p. 176

THERMAL MANAGEMENT

Silica surfaces send the heat away

Dissipating the ever-increasing heat from electronics requires developing materials with high thermal conductivities. Tervo et al. found, through a series of experiments, that packed silica nanoparticle beds coated with different coolant fluids have greatly enhanced thermal conductivity. The increase may be due to the surface properties of the nanoparticles, which are driven by strong surface electrical polarization. This new approach for modulating thermal conductivity presents new opportunities for thermal management. —BG


ORGANIC CHEMISTRY

Carboxylating stubborn alkyld chlorides

The utility of alkyl chlorides and carbon dioxide (CO₂) as reagents in organic synthesis is often limited by the difficulty of activating these molecules. Börjesson et al. have overcome both these challenges with a nickel catalyst that adds CO₂ at ambient pressures to unactivated alkyl chlorides (primary, secondary, and even tertiary). The nickel catalyst ligands that were most effective...
**MICROBIOLOGY**

A viral blight on ocean sunshine sugars

Essentially all organic material derives from photosynthesis. The most numerous photosynthetic organisms are marine picocyanobacteria, which synthesize about 10% of Earth’s organic compounds. Even more numerous marine viruses prey on picocyanobacteria. Putty et al. show that the infecting viruses subvert the metabolism of their picocyanobacteria hosts, boosting the energy-producing reactions of photosynthesis to support viral infection. At the same time, they inhibit the ability of picocyanobacteria to fix CO₂ and synthesize organic material, therefore having a potentially substantial effect on global amounts of organic compounds. —GR


Viruses can affect the metabolism of cyanobacteria.

**HUMAN GENETICS**

Genetics of the great migration

The African American population is underrepresented in genetic studies, and their history of slavery, systemic discrimination, and migration probably shaped their genetic diversity. To better understand this, Baharian et al. analyzed the genetic variation in 3736 individuals from three cohorts representing the diversity of African Americans across the United States. These data identified historical events in the movement and admixture (interbreeding of isolated groups) of African Americans, including the fact that about 1.2% of their ancestry is Native American, which probably traces back to the early period of slavery. Overall, the data illustrate how differences in social opportunity over centuries can shape the genetic diversity of a population. —LZ


**QUANTUM OPTICS**

How a particle gets its quantum kicks

The radiation pressure from a focused laser beam used to cool and trap particles is the basis for advanced optical tweezing methods that have found a diverse range of applications in biology, chemistry, and physics. When a trapped particle is subjected to a force, it shifts its position in the trap, thereby providing the possibility of sensing that force. By confining a 50-nm-diameter silica bead in an ultrahigh vacuum, Jain et al. isolated the particle from environment-induced jiggling and effectively restricted the particle’s motion to that due to quantum optical forces. They then showed that they can measure the recoil rate of photons from the particle, providing the possibility of exploiting the effect for highly sensitive force measurements. —ISO


**ANTIVIRAL IMMUNITY**

Breathing life into the antiviral response

Fighting viruses requires a coordinated attack. Immune cells known as plasmacytoid dendritic cells (pDCs) lie at the heart of the response and, among other functions, secrete large amounts of antiviral proteins called type I interferons (IFNs) that alert the body that it is under attack. Wu et al. report that in addition to eliciting expression of a suite of antiviral genes, type I IFNs also cause cells to modify their metabolism. Type I IFNs signal cells to shift their metabolism toward fatty acid oxidation and oxidative phosphorylation, both in pDCs and in other cell types such as T cells and epithelial cells. Antiviral functions of pDCs required these metabolic changes, and viral clearance in mice required fatty acid oxidation. —KLM

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