**INFLUENZA**

**Broadly reactive drugs for flu**

Drugs for influenza are limited. For those available, viral resistance is rife. Part of the problem is that the virus is constantly mutating. Kadam *et al.* tested the cell entry stage of the virus life cycle as a drug target (see the Perspective by Whitehead). Cell entry is mediated by the major surface glycoprotein hemagglutinin (HA). This stage can be blocked by broadly neutralizing antibodies binding to HA. The authors generated small cyclic peptides that bind to the same sites on HA as the antibodies and mimic their activity. The peptides are cheap and easy to synthesize, are nontoxic to mice, and prevented infection of cells by many types of influenza virus. —CA

*Science*, this issue p. 496; see also p. 450

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**BATTERIES**

**Frozen in time**

The electrochemical processes occurring in a battery are highly dynamic. To understand the complexities of the charge and discharge cycles, you need to be able to watch the processes in situ or to freeze the battery rapidly for ex situ analysis. Li *et al.* applied cryo–electron microscopy techniques commonly used for studying biological samples to examine batteries. They identified the solid electrolyte interphase that forms, observed the interactions of Li with the interphase, and captured the formation of dendrites that can be detrimental to the lifetime of a battery. —MSL

*Science*, this issue p. 506

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**MALARIA**

**Plasmodium parasite entrance and exit**

Sweats and fever are the hallmarks of malaria. Red blood cells are the replication factories for malaria parasites. Fever occurs when the parasites’ merozoite stages burst en masse from red blood cells into the circulation. Nasamu *et al.* and Pino *et al.* discovered that two parasite proteases, plasmepsin IX and X, are essential for mass cell exit (see the Perspective by Boddey). Plasmepsin X is also used by the merozoites to enter a fresh red blood cell to continue the replicative cycle.

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**NANOMATERIALS**

**Non–close-packed nanoparticle arrays**

Films of colloidal nanoparticles usually form dense, close-packed lattices. If binary lattices could be made and one component removed, then a more open array could form, as long as the remaining nanoparticles could be stabilized. Udayabhaskararao *et al.* formed binary superlattices of gold and magnetite nanoparticles at an air-liquid interface that could then be transferred to carbon-coated surfaces (see the Perspective by Kotov). Selective etching of either of the nanoparticles created non–close-packed arrays with vacancies stabilized by the carbon surface. —PDS

*Science*, this issue p. 514; see also p. 448
These two plasmepsins act by regulating the maturation of enzymes required to disrupt host cell membranes. Because these functions are essential for the parasite, the authors used protease inhibitors to show that plasmepsins provide potential drug targets. —CA

Science, this issue p. 538, p. 522; see also p. 445

PULMONARY HYPERTENSION

Progress for PAH

In pulmonary arterial hypertension (PAH), pulmonary arteries are thickened and occluded, and mitochondrial respiration is suppressed. Michelakis et al. treated lungs from PAH patients with dichloroacetate (DCA), a drug that inhibits the mitochondrial enzyme pyruvate dehydrogenase kinase. DCA increased mitochondrial function, but the response was variable. This variable response was mirrored in a phase 1 trial, with some patients showing improved hemodynamics and functional capacity. Interestingly, patients with inactivating mutations in two genes encoding mitochondrial proteins were less responsive to DCA. —CC


CELL BIOLOGY

Elucidating a bacterial sense of touch

Bacteria can adhere to surfaces within the host. This leads to tissue colonization, induction of virulence, and eventually the formation of biofilms—multicellular bacterial communities that resist antibiotics and clearance by the immune system (see the Perspective by Hughes and Berg). Hug et al. show that bacteria have a sense of touch that allows them to change their behavior rapidly when encountering surfaces. This tactile sensing makes use of the inner components of the flagellum, a rotary motor powered by proton motive force that facilitates swimming toward surfaces. Thus, the multifunctional flagellar motor is a mechanosensitive device that promotes surface adaptation. In complementary work, Ellison et al. elucidate the role of bacterial pili in a similar surface-sensing role. —SMH

Science, this issue p. 531, p. 535; see also p. 446

BIOIMIMETICS

Is it a bird, a plane? No, it’s a robot!

Microrobots that can fly and swim need effective propulsion for both air and aquatic environments. They also need to overcome substantial surface tension when transitioning between the two. Chen et al. created a 164-rig microrobot with a gas combustion mechanism and buoyant outriggers. These design components stabilized the microrobot, overcoming the water’s surface tension to allow take-off. A surfactant coating enabled diving, and a flapping-wing configuration provided functional propulsion for both air and water environments. The microrobot could land on an elastic surface, hover in air, submerge into water, and swim. —RLK


REPROGRAMMING

Inflammation and cardiac reprogramming

Tissue repair after a heart attack is a balance between inflammation to remove cell debris and active cell regeneration. Intervening in cell replacement and reprogramming thus offers therapeutic options to promote healing with minimal scar formation by fibroblasts. However, reprogramming of adult fibroblasts into pulsatile cardiomyocytes is not straightforward. To improve the reprogramming protocol, Zhou et al. performed an unbiased screen of 786 transcription factors, epigenetic regulators, cytokines, and nuclear receptors. The screen identified a transcription factor (ZNF281) that associates with the essential cardiac development transcription factor GATA4 to stimulate cardiac reprogramming and suppress inflammatory signaling. Anti-inflammatory drugs also stimulate cardiac gene expression. ZNF281 appears to act at a nexus between cardiac and inflammatory gene programs that exert opposite influences on fibroblast reprogramming. —BAP

Genes Dev. 10.1101/gad.305482.117 (2017).

MICROBIOTA

Drone technology for whale health

It is hard to obtain biological samples from whales. However, whales do shed lots of material as oily slicks behind them and in their massive exhalations, or blows, at the surface. Exhalations contain tissue debris and respiratory microorganisms. Apprill et al. used a small drone furnished with a Petri dish and a 96-well plate to capture exhaled material from 28 humpback whales off Vancouver Island, Canada, and Cape Cod, USA. 16S ribosomal RNA sequencing of bacteria and archaea revealed that animals from the two populations have diverse, distinctive, and yet surprisingly consistent core microbiomes in common with each other and with small, toothed cetaceans: bottlenose dolphins. Fortunately, in this study, no known cetacean
MEMBRANES
Squeezing through a hole
Transport of an ion is usually directly related to its hydrated radius and assumed to be nonflexible. Either a hydrated ion fits through an aperture or it does not, and shape should play a dominant role rather than charge. Esfandiar et al. created nanofluidic devices by stacking structured bulk materials, including graphite, boron nitride, and molybdenum disulfide. They investigated the transport of ions in aqueous solutions through the nanochannels in the devices. Unexpectedly, they observed different behavior for ions of similar hydrated size but opposite charge. —MSL
Science, this issue p. 511

MICROBIOLOGY
Bacterial toxin acetylates lysine residues
A toxin produced by the bacterium that causes cholera has a catalytic activity that contributes to its effects on the cytoskeleton of host cells. Zhou et al. determined the protein structure of the Rho guanosine triphosphatase (GTPase)–inactivation domain of the toxin from Vibrio cholerae and found it to be similar to that of a human fatty acyltransferase. Indeed, the toxin peptide could catalyze fatty acylation of lysine residues of Rho-family GTPases, which regulate the actin cytoskeleton. Such covalent modification of lysine residues in mammalian proteins had been noted before, but the enzymes responsible were not known. —LBR
Science, this issue p. 528

INFRASTRUCTURE
Building the right roads in the right places
The current boom in global infrastructure development is likely to include the construction of millions of kilometers of new roads, particularly in tropical and subtropical regions. In a Perspective, Laurance and Burgués Arrea argue that road planning often overestimates socioeconomic benefits and does not adequately account for road maintenance costs, while also threatening ecosystems and the services that they provide. A proactive planning approach can help to bridge opposing views and guide construction of roads in the right places for the benefit of human society and the natural environment alike. —JFU
Science, this issue p. 442

CANCER
The good side of ceramides
Tumor growth is enhanced by some members of the ceramide family of lipids and the enzymes that produce them. However, Gencer et al. found that C18-20 ceramides synthesized by the enzyme CerS4 acted as tumor suppressors. The ceramides prevented a transforming growth factor–β (TGF-β) receptor complex from activating the Shh pathway. CerS4 inhibited metastases from mammary tumors and the development of the hair-loss disorder alopecia in mice. The TGF-β and Shh pathways are challenging to target pharmacologically; these findings suggest that some ceramides may have therapeutic potential against these pathways in various disorders. —LKF

IMAGING
An ultrasound bioprobe for biological imaging
Biological imaging past the diffraction limit has provided important tools for understanding the chemistry of life. Shekhawat et al. developed a method to detect the phase of scattered ultrasound waves for high-resolution imaging of biological systems in liquid media. They successfully imaged magnetic cores in silica core shell nanostructures and were able to determine localized stiffness of intracellular fibers in thrombin-stimulated endothelial cells. This approach opens applications in biomedical and molecular imaging with sub-surface resolution down to the nanometer scale. —WSW

Edited by Stella Hurtley