Bacterial battles on your skin

Normal human skin is colonized by a variety of normally harmless bacteria. However, one such bacterium, *Staphylococcus aureus*, can aggravate symptoms of atopic dermatitis. Nakatsuji et al. report that other strains of *Staphylococcus* residing on the skin of healthy individuals produce an antimicrobial peptide that can inhibit *S. aureus* growth. Colonization of pigskin or mouse skin with these protective commensals reduced *S. aureus* replication. Furthermore, autologous bacterial transplant in a small number of atopic dermatitis patients drastically reduced *S. aureus* skin burden. This commensal skin transplant has already been approved by the U.S. Food and Drug Administration, and a clinical trial is under way. —LP


How will this molecule smell?

We still do not understand what a given substance will smell like. Keller et al. launched an international crowdsourced competition in which many teams tried to solve how the smell of a molecule will be perceived by humans. The teams were given access to a database of responses from subjects who had sniffed a large number of molecules and been asked to rate each smell across a range of different qualities. The teams were also given a comprehensive list of the physical and chemical features of the molecules smelled. The teams produced algorithms to predict the correspondence between the quality of each smell and a given molecule. The best models that emerged from this challenge could accurately predict how a new molecule would smell. —PRS

Science, this issue p. 820

An algorithm successfully predicts how an unknown molecule will smell.

Faulty blood cells and heart disease

Recent studies have shown that elderly people’s blood cells often harbor mutations in genes encoding certain epigenetic regulators. These mutations can lead to clonal expansion of the mutant blood cells, which increases the risk of blood cancers and cardiovascular disease. Fuster et al. generated a mouse model to investigate how one of these genes, *Tet2*, affects atherosclerosis development (see the Perspective by Zhu et al.). They found that the disease progressed more rapidly in mice transplanted with *Tet2*-deficient bone marrow cells. This was due to increased secretion of interleukin-1β by *Tet2*-deficient macrophages in a process that depended on the action of inflammasomes. —SNV

Science, this issue p. 842; see also p. 798

Very clever bees use tools

One hallmark of cognitive complexity is the ability to manipulate objects with a specific goal in mind. Such “tool use” at one time was ascribed to humans alone, but then to primates, next to marine mammals, and later to birds. Now we recognize that many species have the capacity to envision how a particular object might be used to achieve an end. Loukola et al. extend this insight to invertebrates. Bumblebees were trained to see that a ball could be used to produce a reward. These bees then spontaneously rolled the ball when given the chance. —SNV

Science, this issue p. 833

Spinning up an extragalactic neutron star

Ultraluminous x-ray sources (ULXs) are strange objects in other galaxies that cannot be explained by conventional accretion onto stellar-mass objects. This has led to exotic
interpretations, such as the long-sought intermediate-mass black holes. Israel et al. observed a ULX in the nearby galaxy NGC 5907 and found that it is instead a neutron star. The spinning neutron star is accreting material so fast that its spin period is quickly accelerating. The only way that it can consume enough material to explain these properties is if it has a strong multipolar magnetic field. —KTS

Science, this issue p. 817

PROTEIN DESIGN
Shining a light on cell signaling
Protein kinases are proteins that are used to transmit signals within cells. Zhou et al. engineered diverse kinases so that they could be switched on and off with visible light. They modified the fluorescent protein Dronpa so that instead of being tetrameric, it dimerized in violet light and dissociated in cyan light, and they fused two copies to representatives from different families of kinases. The engineered kinases could be photoswitched with spatial and temporal precision and were successfully used to study a variety of signaling pathways. —VV

Science, this issue p. 816

INFLAMMATION
How red berries reduce inflammation
Members of the interleukin-17 (IL-17) family of proinflammatory cytokines are important in the immune response to infections. However, too much IL-17 signaling is associated with autoimmune inflammatory diseases, such as asthma, psoriasis, and rheumatoid arthritis. Liu et al. performed small-molecule screening to look for compounds that could bind to the IL-17 receptor. They found that cyanidin, a flavonoid found in red berries and other fruits, bound to the IL-17 receptor and blocked the binding of IL-17A. In several mouse models of inflammatory disease, cyanidin alleviated the inflammation induced by IL-17A—producing T cells. —JFF


POLYMERS
How to make opposites compatible
Polyethylene (PE) and isotactic polypropylene (iPP) are the two most widely used commodity plastics and thus make up a large fraction of the waste stream. However, the two plastics will not mix together, which limits options for dealing with mixed waste and decreases the value of recycled products. Eagan et al. report the synthesis of multiblock copolymers of iPP and PE by using a selective polymer initiator (see the Perspective by Creton). The high-molecular-weight blocks could be used to reinforce the interface between iPP and PE and allow blending of the two polymers. —MSL

Science, this issue p. 814; see also p. 797

MAST CELLS
DNA methylation curbs mast cell response
Mast cells are white blood cells that are perhaps best known for their role in allergic responses and asthma. Leoni et al. now show that the enzyme DNMT3A limits mast cell activity following acute and chronic inflammation. Using mice deficient in DNMT3A, the authors found exaggerated mast cell responses to skin allergy. Inactivation of DNMT3A was associated with increased cytokine production, enhanced mast cell degranulation, and aberrant expression of the IQGAP2 scaffold protein. A number of hematological disorders have been associated with mutations in DNA methylation enzymes, and the current studies highlight a broader role for containing immune responses. —PNK


RNA DESIGN
An old motif with new specificity
RNA aptamers bind to small molecules and, in the context of adjacent regulatory domains, can control cellular processes. Synthetic RNA aptamers can be selected against a target, but it is difficult to integrate these artificial sensors into cells. Porter et al. started with scaffolds derived from two different riboswitches and a ribozyme that all contain a recurrent motif. They made libraries designed to maintain the structure, but with sufficient diversity to select sequences that would bind precursors of serotonin and dopamine. They obtained a diverse set of aptamers that selectively bind their target and can be coupled to a fluorophore binding domain for

IN OTHER JOURNALS
Edited by Jesse Smith and Sacha Vignieri
DIVERSE REPLICATION
Diverse molecular choreography of replication

Accurate duplication and transmission of genetic information to the next generation requires complex molecular assemblies. Bleichert et al. review replication initiation across the three domains of life, with a focus on origin selection and helicase loading. These processes identify potential origins of replication and prepare them for subsequent bidirectional replication initiation. There are key similarities and multiple differences in replication mechanisms between eukaryotes, prokaryotes, and archaea and many outstanding questions to be answered. —GR and CA

Science, this issue p. 811

PROTEOMICS
How proteomes take the heat

Living organisms are very sensitive to temperature, and much of this is attributed to its effect on the structure and function of proteins. Leuenberger et al. explored thermostability on a proteome-wide scale in bacteria, yeast, and human cells by using a combination of limited proteolysis and mass spectrometry (see the Perspective by Vogel). Their results suggest that temperature-induced cell death is caused by the loss of a subset of proteins with key functions. The study also provides insight into the molecular and evolutionary bases of protein and proteome stability. —VV

Science, this issue p. 812; see also p. 794

DNA CHARGE TRANSPORT
DNA charged with regulating replication

DNA can transport electrical charge over long distances and has the potential to act as a signaling system. The iron-sulfur complex [4Fe4S] found in some proteins is known to be involved in redox reactions. The eukaryotic DNA primase is involved in DNA replication and contains a [4Fe4S] cluster that is required for its RNA primer synthesis activity. O’Brien et al. show that the [4Fe4S] cluster in DNA primase can regulate the protein’s DNA binding activity through DNA-mediated charge transfer. This in turn plays a role in primer initiation and length determination. —GR and JSY

Science, this issue p. 813

ANTIBIOTIC RESISTANCE
Resistance on a background of tolerance

Bacteria survive antibiotic exposure either because they are quiescent when antibiotics are around in the highest concentrations (i.e., tolerance) or because they acquire active biochemical resistance mechanisms (i.e., resistance). Both tolerance and resistance involve the acquisition of mutations from the wild type. Levin-Reisman et al. used in vitro evolution experiments to show that populations of bacteria that become genetically resistant to the antibiotic ampicillin most quickly do so on a background of tolerance mutations (see the Perspective by Lewis and Shan). Because the probability of a tolerant organism surviving is higher, it has a greater chance of subsequently acquiring resistance mutations. Tolerance is often overlooked in the clinic but should in future be screened for and targeted more precisely to reduce the rates of acquired resistance. —CA

Science, this issue p. 826; see also p. 796

TOXIC AMYLOIDS
What’s in a fold?

Bacterially secreted peptides known as PSMS (phenol-soluble modulins) stimulate inflammatory responses, lyse human cells, and contribute to biofilm structuring. PSMa3 is a virulent 22-residue amyloid peptide secreted by Staphylococcus aureus. Tayeb-Fligelman et al. present a high-resolution structure encompassing the full length of the amyloid’s sequence. This structure reveals an unexpected departure from the common amyloid cross-β fold architecture. Instead, PSMa3 forms amphipathic α-helices that are folded to stack perpendicular to the fibril axis into sheets. This unusual cross-α structure was important for fibril toxicity. —SMH

Science, this issue p. 831

PALEONTOLOGY
How dinosaurs took to the air

Birds use their wings for powered flight, but, as Brusatte explains in a Perspective, this does not mean that wings evolved for this purpose. Early winged dinosaurs were not capable of flight. Later dinosaurs had a range of wing types that likely enabled different capabilities, from gliding to incipient flapping. Only much later did the predecessors of birds evolve the right body size, wing span, and anatomy to enable powered flight. Biomechanical studies are crucial for exploring which winged dinosaurs could move in the air and how they did so. —JFU

Science, this issue p. 792

IMMUNOGENOMICS
Defining the tree rings of T cells

T cell function declines with age. What does T cell aging look like at the molecular level? To understand the transcriptional programs that regulate T cell differentiation and aging, Moskowitz et al. generated genome-wide maps of chromatin accessibility in CD8+ T cells from young and elderly individuals. In naive CD8+ T cells in the elderly, promoters that recruit nuclear respiratory factor 1 (NRF1), which controls expression of mitochondrial proteins, were less accessible. Thus, loss of NRF1 binding could contribute to lower metabolic activity in aged T cells. The transcriptional circuits uncovered by this study set the stage for designing approaches to modulate T cell function in the elderly. —AB


Edited by Stella Hurtley