Selfish genetic element drives nematode maternal-effect lethality

Ben-David et al., p. 1051

PHYSIOLOGY

Why radiation causes dry mouth

Patients with head or neck cancers who receive radiation frequently develop dry mouth, an effect that is not due to cell death in salivary glands. Liu et al. found that the ion channel TRPM2, which is activated by radiation, suppresses saliva production by triggering the cleavage and inactivation of the Ca\(^{2+}\) sensor STIM1. Overexpression of STIM1 in irradiated mice increased saliva production, suggesting that strategies that prevent the loss of STIM1 could prevent the dry mouth associated with irradiation. —WW


QUANTUM MAGNETISM

Sighting of magnetic Majorana fermions?

Quantum spin liquids—materials whose magnetic spins do not settle into order even at absolute zero temperature—have long captured the interest of physicists. A particularly lofty goal is finding a material that can be described by the so-called Kitaev spin model, a network of spins on a honeycomb lattice that harbors Majorana fermions as its excitations. Banerjee et al. present a comprehensive inelastic neutron scattering study of single crystals of the material \(\alpha\)-RuCl\(_3\), which has been predicted to host a Kitaev spin liquid. The unusual dependence of the data on energy, momentum, and temperature is consistent with the Kitaev model. —JS

Science, this issue p. 1055

CHEMISTRY

Designing molecular disorder

Melanins are a group of natural pigments that are the primary factor affecting skin color. Lampel et al. examined a family of melanin-inspired materials based on tripeptides containing tyrosine as precursors for polymeric pigments. They found that the supramolecular organization of the tripeptide assembly is the most important factor for the enzymatic oxidation, with the position of the tyrosine residue playing a dominant role. Thus, simply juggling the order of the peptides allowed tuning of the optical and electrical properties of the resulting polymers. —MSL

Science, this issue p. 1064

ORGANIC CHEMISTRY

Teaching sulfur and phosphorus to share

Wouldn’t it be nice if real chemistry worked like a modeling kit, and you could just pull a group off one molecule and tack it onto another? Lian et al. report that palladium catalysis can swap aryl rings between pairs of organosulfur or organophosphorus fragments in just this way. They showcase the sulfur swap by breaking down the commercial thermoplastic polyphenylene sulfide into simple monomers. —JSY

Science, this issue p. 1059

PHOTOS: (TOP) BOB GOLDSTEIN/UNC CHAPEL HILL/WIKIMEDIA COMMONS; (BOTTOM) SNOWLEOPARD1/ISTOCKPHOTO
and found that they match the heretofore unknown source. The xenon appears to have been trapped in ice within the comet since before the solar system formed. Comets contributed about a quarter of the xenon on Earth, which constrains the amount of other materials (such as water) delivered to our planet by comets. —KTS

**Tissue Repair**

Local Macrophage Clean-Up

Infection, especially by helminths or bacteria, can cause tissue damage (see the Perspective by Bouchery and Harris). Minotti et al. studied mouse models of helminth infection and fibrosis. They expressed surfactant protein A (a member of the complement component C1q family) in the lung, which enhanced interleukin-4 (IL-4)–mediated proliferation and activation of alveolar macrophages. This activation accelerated helminth clearance and reduced lung injury. In the peritoneum, C1q boosted macrophage activation for liver repair after bacterial infection. By a different approach, Bosurgi et al. discovered that after wounding caused by migrating helminths in the lung or during inflammation in the gut of mice, IL-4 and IL-13 act only in the presence of apoptotic cells to promote tissue repair by local macrophages. —CA and KLM

**Biochemistry**

A Clue to a Drug’s Neurotoxicity?

The drug BIA 10-2474 inhibits fatty acid amide hydrolase (FAAH), a lipase that degrades a specific endocannabinoid. On the basis of this activity, BIA 10-2474 was being developed as a potential treatment for anxiety and pain. In a phase 1 trial of the drug, one subject died, and four others suffered brain damage. As an initial step in investigating whether inhibition of off-target proteins by BIA 10-2474 might contribute to its clinical neurotoxicity, van Esbroeck et al. used activity-based proteomic assays to identify proteins targeted by the drug. Studying human cells and brain samples from subjects not associated with the trial, they found that BIA 10-2474 targeted several different lipases in addition to FAAH. It also substantially altered lipid metabolism in cultured neurons. —PAK

**Infectious Disease**

Plasmodium Leftovers Cause Bone Loss

Malaria patients sometimes develop long-term consequences of infection, such as bone loss and growth retardation. Lee et al. found that the Plasmodium by-product hemozoin can remain in the bone marrow and cause bone loss. Mice infected with a mutant Plasmodium that did not produce hemozoin did not undergo bone loss. Hemozoin induced inflammatory responses in osteoclast and osteoblast precursors, resulting in bone resorption. Treating infected animals with alfalfacidol, a vitamin D3 analog, prevented this bone loss. —ACC

**AGING**

DNA Damage Linked to Fitness Loss in Aging

Loss of metabolic function is associated with physical decline and diseases associated with aging. Park et al. provide evidence for a link between accumulated DNA damage and such metabolic dysfunction. Activity of the DNA-dependent protein kinase (DNA-PK), which is activated in response to DNA damage, was increased in skeletal muscle of older mice. DNA-PK phosphorylates HSP90α, a chaperone protein that protects the activity of a key metabolic regulator called adenosine monophosphate–activated protein kinase. A small-molecule inhibitor of DNA-PK improved the physical fitness of young obese mice and older mice. Whether such benefits can be provided without the deleterious effects of inhibited DNA repair, such as cancer, remains to be explored. —LBR

**HIV**

HIV Reprograms Progenitor Cells

Survival rates of patients with HIV have improved enormously as a result of antiretroviral therapy, but increased life expectancy is now associated with a high risk of comorbidities. HIV–associated chronic obstructive pulmonary disease (COPD) often manifests as emphysema, originating around the airways and extending into lung tissue. Chung et al. have discovered that this is caused by HIV binding to basal cells in the airway and activating a tissue-destructive phenotype through a mitogen-activated protein kinase signaling cascade. HIV binding triggers up-regulation of matrix metalloproteinase 9, which is known to be elevated in COPD patients and may contribute to the degradation of extracellular matrix seen in emphysema sufferers. —CHG

**X Inactivation**

Polycomb Steps to Inactivate X

XX females silence one of their X chromosomes. This involves a process whereby a noncoding RNA known as Xist coats one of the X chromosomes and recruits chromatin silencing factors. The Polycomb complexes PRC1 and PRC2 are also known to be involved in X chromosome inactivation. Almeida et al. elucidated a key role of a specific complex, PCGF3/5–PRC1, in initiating Polycomb recruitment by Xist RNA. They further demonstrate that Polycomb recruitment is critical for Xist-mediated chromosome silencing and female embryogenesis. —BAP

**IN OTHER JOURNALS**

Edited by Caroline Ash and Jesse Smith

Inhibiting a DNA-repair kinase improves physical fitness in old mice.

Bacterial sensing mechanism revealed

*Escherichia coli* use a transmembrane sensor protein to sense nitrate in their external environment and initiate a biochemical response. Gushchin et al. compared crystal structures of portions of the NarQ receptor that included the transmembrane helices in ligand-bound or unbound states. The structures suggest a signaling mechanism by which piston- and lever-like movements are transmitted to response regulator proteins within the cell. Such two-component systems are very common in bacteria and, if better understood, might provide targets for antimicrobial therapies. —LBR

*Science, this issue* p. 1043

**GENETICS**

Selfish genetic interactions in nematodes

Identifying the effects and evolution of selfish genetic elements can be difficult because of their biased inheritance. Ben-David et al. identified a selfish genetic element that drives maternal-effect lethality in the nematode *Caenorhabditis elegans* (see the Perspective by Phadnis). This incompatibility stems from the interaction between a maternally deposited toxin and a zygotically expressed antidote. Interestingly, the antidote is encoded by the gene *pha-1*, which has been described as an essential gene in embryonic development. —LMZ

*Science, this issue* p. 1051; see also p. 1013

**IMMUNOGENOMICS**

Tracing development of the dendritic cell lineage

Dendritic cells (DCs) are important components of the immune system that form from the bone marrow into two major cell lineages: plasmacytoid DCs and conventional DCs. See et al. applied single-cell RNA sequencing and cytometry by time-of-flight to characterize the developmental pathways of these cells. They identified blood DC precursors that shared surface markers with plasmacytoid DCs but that were functionally distinct. This unsuspected level of complexity in pre-DC populations reveals additional cell types and refines understanding of known cell types. —LMZ

*Science, this issue* p. 1044

**ORGANIC CHEMISTRY**

Swapping boron acids for carbon acids

Carbon-bound boronic acids and their esters are widely used as coupling partners to make carbon-carbon bonds. More recently, these chemicals have garnered pharmaceutical interest in their own right. Li et al. report a versatile nickel-catalyzed process to replace carboxylic acids with boronate esters by using a phthalimide activator. The reaction is well suited to late-stage modification of complex molecules. The authors used the approach to produce a potent in vitro inhibitor of human neutrophil elastase, a target of interest in treating inflammatory lung diseases. —JSY

*Science, this issue* p. 1045

**MATERIALS SCIENCE**

From glassy carbon to mixed carbon

Forging one of the world’s hardest materials (diamond) from the same atomic carbon building blocks as one of its softest (graphite) has intrigued many a high school chemistry student. This dexterity of carbon originates from its ability to exist in two distinct bonded states, sp² and sp³. Materials in which these two states coexist are highly sought after by materials scientists. Hu et al. report that forging glassy carbon at moderate temperatures yields a series of sp²-sp³ hybrids that possess unusual property combinations. X-ray diffraction, electron microscopy, and electron energy-loss spectroscopy revealed that compression induces local buckling of sp²-bonded graphene sheets through sp³ nodes to form graphene networks with long-range disorder and short-range order. The study defines a roadmap for creating bulk carbon-based materials with previously unachievable property combinations. —LAA

*Sci. Adv. 10.1126/sciadv.1603213 (2017).*

**GRAVITATIONAL LENSING**

General relativity weighs a white dwarf

Light from a background star is deflected by the gravitational field of the Sun. This effect was used in 1919 to provide some of the first evidence for general relativity. Sahu et al. applied the concept to another star: a nearby white dwarf called Stein 2051 B, which passed close in front of a more distant normal star (see the Perspective by Oswalt). The authors measured the tiny shifts in the apparent position of the background star, an effect called astrometric microlensing. The apparent motion matched the predictions of general relativity, which allowed the authors to determine the mass of the white dwarf. —KTS

*Science, this issue* p. 1046; see also p. 1015

**VACCINES**

Moving beyond mice for vaccine studies

That adjuvants can be used to enhance vaccines has been known for decades, but the mechanistic differences in how specific adjuvants influence immune response are just beginning to be elucidated. Liang et al. sought a model that closely mimics humans, so they intramuscularly immunized nonhuman primates with a prototypical HIV antigen in combination with various adjuvants. They then inspected the muscles and lymph nodes to characterize antigen-presenting cells and resulting adaptive immune responses. Their findings should provide valuable information on adjuvant selection for vaccine development in humans. —LP

*Sci. Transl. Med. 9, eaal2094 (2017).*
Sighting of magnetic Majorana fermions?
Jelena Stajic

Science 356 (6342), 1040.
DOI: 10.1126/science.356.6342.1040-b