ADHESIVES

Sticky even when wet
Tissue adhesives are used as an alternative to stitches or staples and can be less damaging to the healthy tissues. But they can suffer from low biocompatibility and poor matching of the mechanical properties with the tissues. Li et al. combined an adhesive surface with a flexible matrix to develop an adhesive that has the right level of stick but moves with the surrounding tissues. The adhesive is effective in the presence of blood and thus might work during wound repair. —MSL

Science, this issue p. 378

X-RAY OPTICS

Spectral narrowing of x-rays
Modern photon factories typically provide x-ray pulses that are orders of magnitude broader in frequency space than the corresponding atomic or nuclear resonances to be probed. For many spectroscopic applications, however, narrower x-ray light sources are desired. By using precise mechanical displacements of a reference absorber to simulate the effect of an x-ray control field, Heeg et al. show that they can spectrally narrow input x-ray pulses. The conversion of off-resonant photons into resonant ones results in increased pulse brilliance at the desired resonant frequency, thereby providing a sharp x-ray probe for precision spectroscopy. —ISO

Science, this issue p. 375

GEOPHYSICS

Iceland’s molten roots
Major hot spot plumes are responsible for basaltic ocean island chains such as Hawaii. Yuan and Romanowicz used seismic tomography, which constructs an x-ray–like picture of Earth’s interior from seismic waves, to show that the root of Iceland’s hot spot plume is partially molten. The partially molten region is located near Earth’s core-mantle boundary and has been challenging to image with geophysical methods. This approach may be applicable to other hot spots with similar areas of melts or other enigmatic regions in the lower mantle. —BG

Science, this issue p. 393

CANCER

A stiff punishment for tumors
The behavior of tumor cells is regulated not only by their own biology, but also by interactions with their microenvironment. A key part of the microenvironment is the extracellular matrix,

PHOTO: GORAN CAKMAZOVIC/SHUTTERSTOCK

NITROGEN POLLUTION

More rain means more pollution
Nitrogen input from river runoff is a major cause of eutrophication in estuaries and coastal waters. This is a serious problem that is widely expected to intensify as climate change strengthens the hydrological cycle. To address the current lack of adequate analysis, Sinha et al. present estimates of riverine nitrogen loading for the continental United States, based on projections of precipitation derived from climate models (see the Perspective by Seitzinger and Phillips). Anticipated changes in precipitation patterns are forecast to cause large and robust increases in nitrogen fluxes by the end of the century. —HJS

Science, this issue p. 405; see also p. 350

An intense algal bloom on a eutrophied river.

IN SCIENCE JOURNALS

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which typically has a greater stiffness in tumors than in surrounding normal tissues. Exploiting this difference, Liu et al. engineered mechanoresponsive mesenchymal stem cells to act as vehicles for cancer drug delivery in a mouse model. The engineered stem cells accumulated in tumors, delivering the first half of a two-part cancer therapy: the enzyme cytosine deaminase. Subsequently, the drug 5-fluorocytosine was delivered systemically, and the cytosine deaminase present in the tumor environment activated the drug to supply local anticancer therapy with no off-target damage. —YN


NEUROSCIENCE

The disappearance of fine motor control

Manual skills are much better developed in primates than in rodents. This difference is in part due to species-specific differences in the control of motoneurons by the brain. Gu et al. used a range of approaches to evaluate potential corticospinal tract projections in neonatal mice. These projections exist immediately after birth but disappear within the first 2 postnatal weeks owing to the actions of plexin A, a member of the semaphorin receptor family. Targeted deletion of semaphorin receptors in mutant mice prevented elimination of corticospinal tract projection and loss of functional monosynaptic input to spinal motoneurons. —PRS

Science, this issue p. 400

CANCER BIOMARKERS

Predicting responses to immunotherapy

Colon cancers with loss-of-function mutations in the mismatch repair (MMR) pathway have favorable responses to PD-1 blockade immunotherapy. In a phase 2 clinical trial, Le et al. showed that treatment success is not just limited to colon cancer (see the Perspective by Goswami and Sharma). They found that a wide range of different cancer types with MMR deficiency also responded to PD-1 blockade. The trial included some patients with pancreatic cancer, which is one of the deadliest forms of cancer. The clinical trial is still ongoing, and around 20% of patients have so far achieved a complete response. MMR deficiency appears to be a biomarker for predicting successful treatment outcomes for several solid tumors and indicates a new therapeutic option for patients harboring MMR-deficient cancers. —PNK

Science, this issue p. 409; see also p. 358

PROTEOSTASIS

A tale of CAT tails

When protein translation fails, the incomplete nascent polypeptide is targeted for degradation by the highly conserved ribosome-associated quality control complex (RQC). Mutations in RQC components lead to stress at the cellular level and neurodegeneration at the organismal level. Recent studies have shown that RQC tags partially synthesize proteins with C-terminal alanine and threonine (CAT) tails in an unusual elongation reaction. Working in yeast, Kostova et al. elucidated the role of this process. CAT-tailing is a failsafe mechanism to ensure the degradation of partially synthesized proteins. The elongation process appears to “push” lysines out of the ribosome exit tunnel, which allows them to be marked by ubiquitin degradation signals. —SMH

Science, this issue p. 414

NEURODEGENERATION

The yin and yang of TDP-43 reduction

The gene that encodes TDP-43 is implicated in frontotemporal lobar degeneration and amyotrophic lateral sclerosis. Microglia are the brain’s innate immune cells, constantly surveying for anything that might interfere with correct brain functions. Paolicelli et al. suggest that TDP-43 is a regulator of microglia function. In an inducible conditional knockout mouse line crossed to an Alzheimer’s mouse model, the depletion of TDP-43 from brain microglia resulted in a decrease in brain amyloid. Such a reduction in amyloid might be construed as beneficial. However, the mice also exhibited a reduction in synaptic markers and displayed signs of neurodegeneration. Thus, TDP-43 plays a role in modulating microglia-mediated clearance. In neurodegeneration, such abnormal phagocytic activity could be detrimental if it promotes excessive microglial-mediated synaptic removal, despite enhanced amyloid clearance. —SMH

Neuron10.1016/j.neuron.2017.05.037 (2017).

WORKFORCE

Support is needed to leave the lab

As doctoral recipients in STEM (science, technology, engineering, and mathematics) fields increasingly move to nonacademic positions, graduate training programs struggle to design strategies and resources that prepare graduates for a broad job market. St. Clair et al. investigated factors that affect the career search confidence and job search strategies of doctoral trainees. Using data from an NIH-funded survey of biomedical doctoral students and postdoctoral fellows, the team found that trainee perceptions of institutional support show that how trainees perceive their support systems (or lack thereof) has a strong direct effect on their career search efficacy, as well as the types of career development strategies that they adopt. Although this research shows the importance

IN OTHER JOURNALS

Edited by Sacha Vignieri and Jesse Smith

TDP-43 in microglia reduces brain amyloid, but with a cost.
METABOLISM
From stomach ache to depression

Our gut hurts and we feel miserable. Such disparate phenomena are mechanistically connected, but how? Cervenka et al. review the many pathways taken by dietary tryptophan as it is metabolized into kynurenines. These metabolites distribute into homeostatic networks that integrate diverse aspects of mammalian physiology. Depending on physiological context, kynurenines influence health and disease states ranging from intestinal conditions to inflammation to cancer progression. Further, they can mediate the effects of exercise, mood, and neuronal excitability and, ultimately, communicate with the microbiota. —CA

Science, this issue p. 369

ULTRACOLD MOLECULES
Extending the coherence time of molecules

Quantum properties of atoms and molecules can be exploited for precision measurements or quantum information processing. The complex state structure of molecules can be exploited, but it is hard to preserve the coherence between pairs of those states in applications. Park et al. created fermionic molecules of NaK in the rovibrational ground state that maintained coherence between their nuclear spin states on a time scale of 1 second. This long coherence time makes dipolar ultracold molecules a valuable quantum resource. —JS

Science, this issue p. 372

CHROMATIN STRUCTURE
A close-up view inside the nucleus

The nuclei of human cells contain 2 meters of genomic DNA. How does it all fit? Compaction starts with the DNA wrapping around histone octamers to form nucleosomes, but it is unclear how these further compress into mitotic chromosomes. Ou et al. describe a DNA-labeling method that allows them to visualize chromatin organization in human cells (see the Perspective by Larson and Misteli). They show that chromatin forms flexible chains with diameters between 5 and 24 nm. In mitotic chromosomes, chains bend back on themselves to pack at high density, whereas during interphase, the chromatin chains are more extended. —VV

Science, this issue p. 370; see also p. 354

DNA NANOTECHNOLOGY
Relaying information on DNA tiles

Arrays of modular DNA units can relay information by transforming their internal shape in response to binding of DNA trigger strands. Song et al. synthesized rectangular arrays of double-stranded DNA (see the Perspective by Yang and Lin). Transient square configurations transform into two stable rectangular structures by pinching across a pair of opposing vertices. Binding of DNA trigger strands causes switching into the alternative stable configuration. The tiles thus create a cascade of transformations along a particular pathway, thereby transmitting information about where binding occurred. —PDS

Science, this issue p. 371; see also p. 352

HIGH-PRESSURE PHYSICS
Atomic hydrogen with an iron assist

Metal polyhydrides can be used at lower pressures to make material that might have atomic hydrogen bonding. Pépin et al. manage to synthesize an incredibly hydrogen-rich FeH, compound at 130 GPa pressure. The material consists of slabs of four thin planes of atomic hydrogen intercalated with layers of quasicubic FeH₂ units. These metal polyhydrides were stable at far more accessible pressures than pure hydrogen. This achievement provides an opportunity to investigate special electrical properties expected from atomic hydrogen bonding, such as superconductivity. —BG

Science, this issue p. 382

CATALYSIS
Low-temperature CO removal

Carbon monoxide deactivates fuel cell catalysts, so it must be removed from H₂ generated from hydrocarbons on site. Yao et al. developed a catalyst composed of layered gold clusters on molybdenum carbide (MoC) nanoparticles to convert CO through its reaction with water into H₂ and CO₂ at temperatures as low as 150°C. Water was activated on MoC to form surface hydroxyl groups, which then reacted with CO adsorbed on the gold clusters. —PDS

Science, this issue p. 389

NANOMATERIALS
Flat-out failure of copper films

As integrated circuits shrink in size, so does their nanocrystalline metal wiring. Defects at the interfaces between crystallites (grain boundaries) can degrade wires’ electrical and thermal conductivity, as well as their longevity. Using scanning tunneling microscopy, Zhang et al. showed that the surfaces of nanocrystalline copper films are not flat but rather have ridges and valleys created by the grains rotating out of plane, which then introduces grain boundary defects. Such defects might be avoided if films of different orientations could be grown. —PDS

Science, this issue p. 397

INTESTINAL BOWEL DISEASE
Context is critical in IBD

The intestine hosts trillions of commensal microbes—the microbiota. Exactly how these microbes contribute to a balanced immune response in the intestine is still being explored. Now, Chai et al. report that mucosal-associated Helicobacter spp. can trigger either regulatory T cell (Treg) or effector T cell (Teff) activation in the mouse intestine, depending on the context. In homeostatic conditions, T cells specific to the microbiota activated Tregs. In contrast, in a mouse model of colitis, Helicobacter spp. induced Teff. Helicobacter spp. may thus induce immune tolerance in homeostatic conditions but switch to causing pathogenesis if inflammation develops. —ACC

METABOLISM

When fat is more important than muscle

Natriuretic peptides alter metabolism in combination with blood pressure effects. Wu et al. found that mice with enhanced natriuretic peptide signaling in muscle gained weight and became insulin-resistant on a high-fat diet. In contrast, mice with enhanced natriuretic peptide signaling in adipose tissue were protected from diet-induced obesity. Obese individuals have decreased circulating natriuretic peptide levels. Hence, boosting natriuretic peptide signaling in adipose tissue could offer a route to counteracting obesity. —WW


BIODIVERSITY

Nature’s nature is not random

Little in nature rivals the complexity inherent in ecological communities, where organisms, populations, and species are intricately linked to one another in networks of facilitative and antagonistic interactions. Such complexity seems to be a formula for random, even chaotic, fluctuations. Gotelli et al., making use of a worldwide set of long-term studies, found that more than 90% of the communities that they examined consistently returned to their long-term average composition over time, indicating that community composition is regulated. If anthropogenic impacts disrupt intrinsic regulatory processes, ecological communities may undergo dramatic change or even collapse. —SN