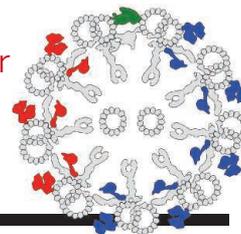


RESEARCH

Cryo-ET elucidates flagellar motor mechanisms

Lin and Nicastro, p. 396



IN SCIENCE JOURNALS

Edited by Stella Hurtley



PSYCHOLOGY

Cultural differences in Starbucks

For thousands of years, people in northern China grew wheat, whereas people in southern China farmed rice. The latter required shared labor and coordinated irrigation. Rice cultivation thus fostered an interdependent culture distinct from the more individualistic wheat-growing culture. Talhelm *et al.* wanted to understand whether traits related to rice versus wheat farming still influence culture today. They observed Starbucks customers in six Chinese cities. Customers in rice-growing regions were less likely to sit alone and squeezed themselves through narrow aisles, whereas customers in wheat-growing regions were more likely to move a chair blocking their way. Thus, it seems that historical cultural differences related to farming may continue to influence people's behavior. —PJB

Sci. Adv. 10.1126/sciadv.aap8469 (2018).

A Starbucks cafe in Shenzhen, China

QUANTUM ENTANGLEMENT

Splitting the entanglement

When particles in a quantum mechanical system are entangled, a measurement performed on one part of the system can affect the results of the same type of measurement performed on another part—even if these subsystems are physically separated. Kunkel *et al.*, Fadel *et al.*, and Lange *et al.* achieved this so-called distributed entanglement in a particularly challenging setting: an ensemble of many cold atoms (see the Perspective by Cavalcanti). In all three studies, the entanglement was first created within an atomic cloud, which was then allowed to expand. Local measurements on the different, spatially

separated parts of the cloud confirmed that the entanglement survived the expansion. —JS

Science, this issue p. 413, p. 409, p. 416; see also p. 376

POLYMERS

Recycle, recycle, recycle

Some polymers, such as polyethylene terephthalate in soft drink bottles, can be depolymerized back to the starting monomers. This makes it possible to repolymerize true virgin material for repeated use. Zhu *et al.* developed a polymer based on a five-membered ring cyclic monomer derived from γ -butyrolactone that could be produced at ambient temperature and mild conditions (see the Perspective by Sardon and Dove). The

high-molecular-weight polymer exhibited high crystallinity and thermal stability. However, at hot enough conditions, or at lower temperatures in the presence of a zinc chloride catalyst, the polymer could be returned to its starting monomers and thus recycled into new material. —MSL

Science, this issue p. 398; see also p. 380

BIOTECHNOLOGY

Taking CRISPR technology further

CRISPR techniques are allowing the development of technologies for nucleic acid detection (see the Perspective by Chertow). Taking advantages of the distinctive enzymatic properties of CRISPR enzymes,

Gootenberg *et al.* developed an improved nucleic acid detection technology for multiplexed quantitative and highly sensitive detection, combined with lateral flow for visual readout. Myhrvold *et al.* added a sample preparation protocol to create a field-deployable viral diagnostic platform for rapid detection of specific strains of pathogens in clinical samples. Cas12a (also known as Cpf1), a type V CRISPR protein, cleaves double-stranded DNA and has been adapted for genome editing. Chen *et al.* discovered that Cas12a also processes single-stranded DNA threading activity. A technology platform based on this activity detected human papillomavirus in patient samples with high sensitivity. —SYM

Science, this issue p. 439, p. 444, p. 436; see also p. 381

CREDITS: (FROM TOP) J. LIN ET AL.; SORBIS/SHUTTERSTOCK.COM

METABOLISM

When beige is not boring

Shifting energy-storing white adipocytes or their progenitors into energy-burning beige adipocytes could be a strategy to combat obesity. Working in mice, Babaei *et al.* found that transient inflammation induced adipocyte progenitors to differentiate into beige adipocytes (see the Focus by Sun *et al.*). Unfortunately, mitophagy causes beige adipocytes to revert to white adipocytes in the absence of “browning” stimuli. Lu *et al.* found that a browning stimulus prevented the mitochondrial recruitment of the mitophagy factor Parkin and that Parkin-deficient mice maintained beige fat upon stimulus withdrawal (see the Focus by Sarraf and Youle). —WW

Sci. Signal. **11**, eaap8526, eaai7838; see also eaat1082, eaat3192 (2018).

OCEAN HYPOXIA

Haunted by the past

Reducing the extent of hypoxia in the Gulf of Mexico will not be as easy as reducing agricultural nitrogen use. Van Meter *et al.* report that so much nitrogen from runoff has accumulated in the Mississippi River basin that, even if future agricultural nitrogen inputs are eliminated, it will still take 30 years to realize the 60% decrease in load needed to reduce eutrophication in the Gulf. This legacy effect means that a dramatic shift in land-use practices, which may not be compatible with current levels of agricultural production, will be needed to control hypoxia in the Gulf of Mexico. —HJS

Science, this issue p. 427



“Legacy” nitrogen in river runoff into the Gulf of Mexico continues to cause hypoxia.

NEUROSCIENCE

Memories are stored in synapses

Memory formation is thought to change the strength of synaptic connections between neurons. However, direct measurements between neurons that participate in a learning process are difficult to obtain. Choi *et al.* developed the “dual-eGRASP” technique to identify synaptic connections between hippocampal CA3 and CA1 pyramidal cells. This method could label two different sets of synapses so that their convergence on the same dendrites would be quantified. After contextual fear conditioning in mice, the number and size of spines were increased on CA1 engram cells receiving input from CA3 engram cells. —PRS

Science, this issue p. 430

REGENERATION

A recipe for regeneration

Unlike humans, planarian flatworms can regenerate certain tissues. During regeneration, existing tissues remodel, and undifferentiated and progenitor cells convert into specialized cell types at specified locations. Atabay *et al.* examined planarian eye regeneration (see the Perspective by Tanaka). Surgical and transplantation experiments revealed three properties governing regenerative progenitor behavior: cell self-organization, an extrinsic migratory target for progenitors, and a broad progenitor-specification zone. Predictions from this model enabled generation of animals with multiple stable eyes. —BAP

Science, this issue p. 404; see also p. 374

IN OTHER JOURNALS

Edited by **Caroline Ash**
and **Jesse Smith**



SCHOLARLY PUBLISHING

Lessons learned from the JACS Challenge

How do we gauge the importance of a scientific publication? Citation counts are, by their nature, crowdsourced, but their inherent meaning is somewhat unclear. To explore this question in more depth, Borchardt *et al.* asked chemists in a survey to look back at a 10-year-old issue of the *Journal of the American Chemical Society* (JACS) and predict, without checking, which three papers had been most highly cited. Respondents were also asked which papers they construed as most important and which they would share with other chemists or the public more broadly. Citations not only proved rather hard to predict, but also correlated poorly with the papers chosen to share. —JSY

PLOS ONE **13**, e0194903 (2018).

DIABETES

Staving off diabetes

Childhood obesity is a growing epidemic associated with increased risk of health issues

later in life. Bjerregaard *et al.* asked whether, and at what age, shedding of excess pounds by overweight kids influenced their chance of developing type 2 diabetes as adults. The authors examined more than 62,000 Danish men for whom height and weight data were available from childhood into early adulthood. Individuals who were overweight throughout adolescence were four times as likely to develop adult type 2 diabetes. However, males who lost excess weight by age 13 cut their diabetes risk to that of those who were never overweight. Thus, maintaining a healthy body mass index throughout adolescence should reduce future chances of type 2 diabetes in men. —PNK

N. Engl. J. Med. 10.1056/NEJMoa171323.1 (2018).

HEMATOPOIESIS

Gut bugs encourage hematopoietic recovery

Antibacterial measures are vital to the success of many clinical interventions. But increasing evidence shows that we need to be more discriminating in our

ALSO IN SCIENCE JOURNALS

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CILIA AND FLAGELLA

Switching how to make flagella beat

Motile cilia and flagella are hairlike cellular appendages that power the movement of individual cells or liquid across tissues, as exemplified by the cilia found in airways. The question of how they move in rhythmic oscillations has puzzled scientists for centuries. Lin and Nicastro used cryo-electron tomography (cryo-ET) to visualize the activity states of individual dynein motors with respect to their locations within beating flagella. They observed an asymmetric distribution of dynein activity and the switching of conformations of dyneins and their regulators between opposite sides of active flagella. The results confirm the switching aspect of the prevailing “switch-point” hypothesis but change the view with respect to how dynein activities are coordinated to drive flagellar motility. —SMH

Science, this issue p. 396

BIOMECHANICS

Hop, skip, jump, or massive leap

In biological and engineered systems, an inherent trade-off exists between the force and velocity that can be delivered by a muscle, spring, or combination of the two. However, one can amplify the maximum throwing power of an arm by storing the energy in a bow or sling shot with a latch mechanism for sudden release. Ilton *et al.* used modeling to explore the performance of motor-driven versus spring-latch systems in engineering and biology across size scales. They found a range of general principles that are common to animals, plants, fungi, and machines that use elastic structures to maximize kinetic energy. —MSL

Science, this issue p. 397

ORGANIC CHEMISTRY

Light and acid steer a radical addition

So-called Minisci reactions have been used for decades in pharmaceutical and agrochemical synthesis to make carbon-carbon bonds. The reactions link carbon radicals to the carbon centers adjacent to nitrogen in pyridine rings. Proctor *et al.* devised a method to steer these reactions to just one of two possible mirror-image products. To make the radicals, they prepared derivatives of widely available amino acids and then activated them with an iridium photocatalyst. At the same time, a chiral phosphoric acid catalyst was used to activate the pyridine and bias the reaction geometry. —JSY

Science, this issue p. 419

BIOPHYSICS

Watching proteins' weight

Careful measurements of light scattering can provide information on individual macromolecules and complexes. Young *et al.* used a light-scattering approach for accurate mass determination of proteins as small as 20 kDa (see the Perspective by Lee and Klenerman). Movies of protein complex association and dissociation were analyzed to extract biophysical parameters from single molecules and assemblies without labeling. Using this approach, the authors determined *in vitro* kinetics of fibril and aggregate growth and association constants for a complex protein-glycoprotein assembly. —MAF

Science, this issue p. 423;
see also p. 378

IMMUNOLOGY

Immunometabolism as therapeutic target

Dimethyl fumarate (DMF) is an immunomodulatory compound

used to treat multiple sclerosis and psoriasis whose mechanisms of action remain only partially understood. Kornberg *et al.* found that DMF and its metabolite, monomethyl fumarate, succinate the glycolytic enzyme GAPDH (see the Perspective by Matsushita and Pearce). After DMF treatment, GAPDH was inactivated, and aerobic glycolysis was down-regulated in both myeloid and lymphoid cells. This resulted in down-modulated immune responses because inflammatory immune-cell subsets require aerobic glycolysis. Thus, metabolism can serve as a viable therapeutic target in autoimmune disease. —STS

Science, this issue p. 449;
see also p. 377

DIAGNOSTICS

A fluid transition into the field

Many point-of-care diagnostics rely on lateral flow assays or microfluidics; however, these methods generally cannot test multiple samples simultaneously. Ng *et al.* optimized inkjet-printed digital microfluidic cartridges and a portable control system to perform serological immunoassays in remote settings. Digital microfluidics use electrostatic forces to mix and separate reagents and samples in small droplets of fluids. The system measured immunoglobulin G (IgG) antibodies for measles and rubella in human blood samples obtained from adults and children on site in a refugee camp in Kenya. Four samples could be tested simultaneously, although digital microfluidic IgG detection was less sensitive and specific than laboratory-based ELISA (enzyme-linked immunosorbent assay) testing of matched serum samples. The emergence of this field-compatible technology brings with it tools for advancing

global health. —CC

Sci. Transl. Med. **10**, aar6076 (2018).

THYMUS

Fueling T cell proliferation

Previous studies on BRCA1-associated protein-1 (BAP1) have documented its importance in suppressing the development of myeloid leukemia. BAP1 is a deubiquitinase (DUB) that acts on histone H2A monoubiquitinated at Lys¹¹⁹ (H2AK119ub), a chromatin modification associated with gene repression. Arenzana *et al.* report that BAP1 is essential for the development of T cells in the thymus and for promoting peripheral T cell proliferation. Deletion of BAP1 impaired expression of genes associated with cell cycle progression in thymocytes and peripheral T cells. In both cases, the effect of BAP1 deletion was dependent on the DUB activity of BAP1, calling for a closer examination of the role of H2AK119ub in T cell development and differentiation. —AB

Sci. Immunol. **3**, eaal1953 (2018).