



PLANT SCIENCE

## Neuroexcitatory Starfruit

The starfruit (*Averrhoa carambola*), so named for the starlike shape generated when the fruit is cut in cross section, adds a tropical note to diverse diets. However, those with kidney failure have an unusual reaction to ingesting starfruit that includes hiccups, mental confusion, and seizures. Garcia-Cairasco *et al.*, analyzing the response of kidney-damaged rats to starfruit extracts, have now identified the toxic element. The key compound is not the nephrotoxic oxalic acid, known to be present in the fruit, but rather is a molecule somewhat like phenylalanine, which the authors have named caramboxin. When injected into rat brains, caramboxin has a neuroexcitatory effect. Experiments with brain slices showed that caramboxin has properties of a glutamatergic receptor agonist. With this potent natural product, the starfruit may be useful for more than gracing a salad. — PJH

*Angew. Chem. Int. Ed.* **52**, 10.1002/anie.201305382 (2013).

INFECTIOUS DISEASE

## Nonrandom and Nonoverlapping

Evolutionary pressure from pathogens appears to have generated diversity in alleles of immune response genes known as *human leucocyte antigen (HLA)*. It remains unclear, however, how this mechanism resulted in the dominance of certain *HLA* allele combinations. Penman *et al.* investigated particular associations of *HLA* alleles with protection against death from specific pathogens using a mathematical model for the simple case of a two-locus two-allele system. The model reveals that a pathogen population evolves, which extirpates homozygote hosts and then enters dynamic coevolutionary cycling of heterozygotes. The consequence is that strain structure evolves in the pathogen population as a result of this immune selection and results in nonrandom and nonoverlapping associations among the *HLA* immune recognition alleles of the host. — CA

*Proc. Natl. Acad. Sci. U.S.A.* **10**, 10731/pnas.1304218110 (2013).

ECONOMICS

## Learning by Doing

Many have championed the importance of formal education for industrial innovation and technical change in a modern economy. On-the-job training, however, or learning by doing, is critical as well. Despite this importance, theorists and managers still lack fine-grained details about how such knowledge is acquired, aggregated, transmitted, and embodied in a production process. Levitt *et al.* studied an auto

assembly plant that was, in many respects, starting over, having just completed major changes in assembly line layout, in types of vehicle assembled, and into new production teams. Over the course of a year, they tracked hundreds of line workers and the 189,000 vehicles they made. They measured hundreds of features on each vehicle, from the torque applied to a bolt to defects in the fit of parts, and the timing of each production step. Defect rates and production times both improved dramatically over the first 7 weeks, at which point a second shift began working on the same line. Despite minimal overlap between first- and second-shift workers, second-shift defect rates began, and remained,



slightly better than for the first shift, who had a 7-week head start. Features that were more defect-prone in shift one were similarly more defect-prone in shift two. Defect rates and production time spiked up again when new styles of vehicle were introduced. The authors discuss the

importance of institutional systems to harness and apply this knowledge, and speculate as to why workers might voluntarily “overshare” their hard-earned and valuable knowledge with management. — BW

*J. Politi. Econ.* **121**, 643 (2013).

EDUCATION

## Women in Physics

Women continue to be underrepresented in physical science classes and careers. Hazari *et al.* tested five hypotheses regarding what factors might affect women’s interest: having a single-sex class, having a female teacher, having a

female scientist guest speaker, discussing the work of female scientists, and discussing the underrepresentation of women in physics. Based on data from the Persistence Research in Science and Engineering project, which surveyed a sample of over 7000 U.S. college students, individuals were identified as being part of the treatment or control groups by virtue of having experienced, or not experienced, each of the five hypotheses. Next, students were matched so that the females in both treatment and control groups had equal prior physical science career interest, and students were asked to rate the likelihood that they would choose a

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career in physical sciences. Women who were exposed to discussions about the underrepresentation of women in the physical sciences were more likely to choose a career in physics than those who were not. Such student-centered discussions afford more opportunities for female students to picture themselves as physical scientists. On the other hand, the lack of support for the other hypotheses invalidates the common belief that female role modeling is necessary for attracting women. — FB

*Phys. Rev. ST Phys. Educ. Res.* **9**, 020115 (2013).

#### ENVIRONMENTAL SCIENCE

### Nanosilver Lining

From socks to children's toys, nanoparticles of metallic silver (i.e., "nanosilver") are being incorporated into more and more consumer



products for their antimicrobial properties. But as these products are used or reach the end of their life cycle and enter the waste stream, they can have negative impacts on natural or engineered microbial communities, such as those in wastewater treatment plants or compost reactors. Gitipour *et al.* analyzed the impact that realistic low levels of silver nanoparticles had on the microbial communities responsible for biodegrading disposed organic matter during composting. In compost treated with nanosilver or free silver ions, the species present in the bacterial communities differed from a control reactor without any added silver; however, the physical properties of the aged compost and leachate were nearly identical between treatments. Statistical analysis of DNA sequencing data suggests that functional redundancy within the bacterial communities played an important role in maintaining efficient biodegradation. Furthermore, strong associations with organic matter may explain why spectroscopic analyses could not detect surface reactions of silver nanoparticles with abundant anions such as chloride, potentially limiting the bioavailability and toxicity of silver in the compost. — NW

*Environ. Sci. Technol.* **10.1021/es402510a** (2013).

#### SIGNALING

### Nuclear Receptor Partner

Drugs that activate glucocorticoid nuclear hormone receptors are commonly used in the clinic for their anti-inflammatory actions, or to slow the growth of some cancers. The ways in which these receptors, which function as transcription factors in the nucleus, modulate a broad set of genes that make up a quarter of the genome are not fully understood. Revollo *et al.* show that another transcription factor, HES1 (hairy and enhancer of split-1), has a general role to restrain glucocorticoid-dependent gene expression. HES1 is well known for its function during development in another signaling pathway, the Notch signaling pathway. Revollo *et al.* show that in adult mice, HES1 acts at glucocorticoid-responsive genes to inhibit transcription and

that it also strongly influences the range of genes that are responsive to glucocorticoids. In order to regulate many of its targets, it appears that a primary effect of the glucocorticoid receptor is to first repress transcription of the gene encoding HES1. This relieves inhibition by HES1 and allows the glucocorticoid receptor to activate its targets and produce its wide-ranging effects that support physiological responses to stress. — LBR

*Sci. Signal.* **6**, 10.1126/scisignal.2004389 (2013).

#### APPLIED PHYSICS

### Enhancing Diamond

The thermal, mechanical, optical, and transport properties of diamond make it an ideal material for applications in high-end power electronics and high-frequency devices. More recently, the quantum properties of the various individual defects in diamond, particularly the nitrogen vacancy defect, also make it attractive for quantum information processing and quantum optical applications. Melville *et al.* demonstrate the potential to enhance that functionality even further by epitaxially growing a single-crystal europium oxide (EuO) layer on a diamond substrate. The EuO layer is a low-temperature ferromagnet and provides the possibility of controlling the properties of diamond magnetically. Varying the growth parameters of the EuO layer to manipulate the strain or expanding the search for other compatible functional oxides provides the opportunity of adding further control knobs for the already multipurpose diamond. — ISO

*Appl. Phys. Lett.* **103**, 222402 (2013).