

ECOLOGY

Relationship Trajectories

Changing climates cause shifts in the geographical distributions of species and in their abundance, as well as in their biological features, such as the timing and duration of reproductive seasons. These shifts can lead to alterations in the strength and effects of the interactions between species in ecological communities, and hence to evolutionary trajectories. Northfield and Ives model how competition, predation, and mutualism are affected by coevolution when climate change affects interacting partners in different ways. When the partners are affected in conflicting ways, coevolution tends to mitigate these effects, but where the effects are nonconflicting, they can be exacerbated by coevolution and can even increase the likelihood of extinction for one or both partners. Their models suggest various experimental scenarios for investigating how coevolution drives species interactions under climate change. Pringle *et al.* show how the strength of a mutualistic interaction, in which the tropical ant (*Azteca* sp) protects a plant (*Cordia alliodora*) against insect herbivores in return for receiving sugar from the plant, varies with the extent of water stress. When less water is available, the mutual dependence of the two partners is increased, illustrating how a shift from one climatic regime to another might alter the future relations of interacting species. — AMS

PLOS Biol. **11**, e1001685; e1001705 (2013).

a plume of debris, dust, and vapor that contained water. The plume and its contents were detected by the Lunar Crater Observation and Sensing Satellite Shepherding Spacecraft that followed the impacting rocket stage into the crater (see Research Articles, 22 October 2010, p. 463). Apart from a sodium enhancement in the exosphere of the Moon, no Earth-based detections were reported, even though observations were attempted. Strycker *et al.* used a principal-components analysis to tease out the impact plume from visible images obtained on 9 October 2009 with the Agile camera on the Astrophysical Research Consortium 3.5-m telescope at the Apache Point Observatory in New Mexico, USA. Their analysis reveals that the plume had separate low- and high-angle components, as suggested by previous results from laboratory work but not verified by the observations made by the Shepherding Spacecraft. The study also confirms that the concentration of water ice in the regolith at the impact site is about 6% by mass. — MJC

Nat. Commun. **4**, 2620 (2013).

NEUROSCIENCE

Too Soon

Familial dysautonomia arises from the inappropriate splicing of an mRNA that encodes a kinase inhibitor; this affects sensory and autonomic functions of the peripheral nervous system, and those affected die young. George *et al.* have looked at the function of the inhibitor in the neural crest lineage, which is the source of much of the peripheral nervous system. In mice without the inhibitor, there were

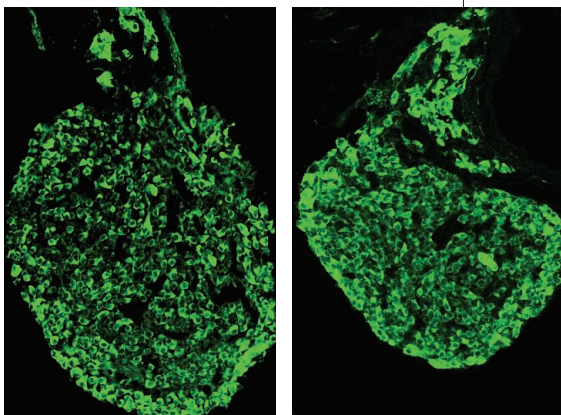
fewer than normal neurons in the superior cervical ganglia and dorsal root ganglia (DRG). Particularly depleted were neurons expressing the neurotrophin receptor TrkA. Their analysis of embryonic mouse development showed that the inhibitor was present in progenitor cells and in postmitotic neurons representing the second wave of neurogenesis in the DRG, the wave that produces TrkA-positive nociceptors and thermoreceptors. Without the inhibitor, this subgroup of progenitors differentiates too early, resulting in a precocious excess of these sensory neurons but depleting progenitors, so that the numbers of neurons fail to keep pace with subsequent development. — PJH

Proc. Natl. Acad. Sci. U.S.A. **110**, 10.1073/pnas.1308596110 (2013).

BIOPHYSICS

Pattern Sensing

More than 60 years ago, Alan Turing described how self-regulated biological patterns could arise in his reaction-diffusion model: An activator and a repressor interact and diffuse at different rates. Payne *et al.* developed a synthetic system to implement this model by engineering two circuits into bacteria: (i) a mutant T7 RNA polymerase that activates its own promoter plus cyan fluorescent protein (CFP), and (ii) an inhibitory circuit containing the gene for lysozyme, which inhibits T7 RNA polymerase and was linked to the fluorescent mCherry protein. The T7 RNA polymerase induced expression of LuxI, which is involved in the synthesis of acyl-homoserine lactone (AHL). High concentrations of AHL induced LuxR expression, which in turn induced the expression of T7 lysozyme, resulting in the inhibition of the T7 RNA promoter. Microcolonies, launched from individual cells, displayed a CFP core and an mCherry ring. Modeling studies incorporating the metabolic burdens imposed by the circuits suggested that cell growth and gene expression were linked so that the activation signal acted as a timing



PLANETARY SCIENCE

Teasing Out the Plume

On 9 October 2009, the second stage of the rocket that launched the Lunar Reconnaissance Orbiter plunged into the Cabeus crater on the south pole of the Moon, lifting

mechanism that enabled the colony to sense its environment. The larger the environment, the longer it took for the activating signal to reach a critical concentration that triggered pattern formation and the larger the ring. — BJ

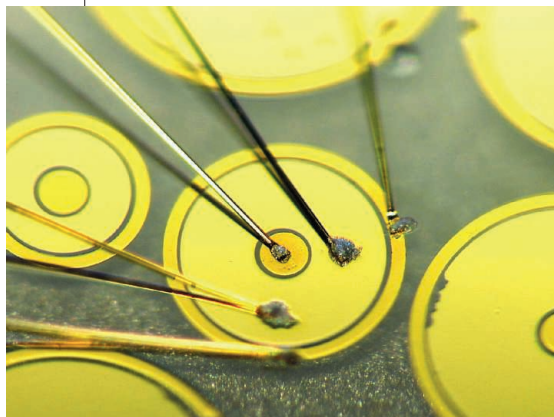
Mol. Syst. Biol. **9**, 697 (2013).

CELL BIOLOGY

Muscle Mitophagy

Mitochondrial injury triggers an adaptive compensatory response: Signals emanating from damaged mitochondria activate cytoprotective cascades that restore cellular homeostasis. Identifying cytoprotective factors has been difficult, in part because of the heterogeneity of tissue culture models of mitochondrial distress. Owusu-Ansah *et al.* have established a *Drosophila* model in which modest muscle mitochondrial perturbation was associated with the induction of genes required for cytoprotection and cell maintenance. A synthetic lethal screen for increased life span and preserved muscle function uncovered components of the mitochondrial unfolded protein response (UPR^{mt}) and a homolog of insulin-like growth factor-binding protein 7, which indirectly facilitates mitophagy—the removal of damaged mitochondria. Overexpression of UPR^{mt} genes in fly muscles preserved mitochondrial function and delayed age-related locomotory impairment. — SMH

Cell **155**, 699 (2013).



students' debate and communication skills and should be replaced with computer-graded short-answers essays. — FB

J. Sci. Educ. Technol.

10.1007/s10956-013-9461-9 (2013).

PHYSICS

Interface Pseudogap

The superconductivity of copper oxide compounds, which in some cases can persist to temperatures above 100 K, is inextricably connected to the pseudogap phase, a range of energies that has very few electronic states associated with it. This phase appears well above the superconducting critical temperature T_c and its origin is still under debate. It could be a consequence of a competing order or simply a precursor to superconductivity. Richter *et al.* studied the behavior of the electronic density of states (DOS) of a different superconducting

EDUCATION

Evaluating Computer Scoring

The preferred way to evaluate science students' argumentation and communication skills is through written essays and oral interviews. Because these assessment methods are time-consuming for teachers, automated grading machines are being developed. Beggrow *et al.* tested the knowledge of 104 undergraduate students exposed to varying amounts of biological evolution content by using three types of assessment: an oral interview with two researchers; a written, open-response assessment scored by both a human and a computer; and a multiple-choice test scored by a computer. Regression and correlation analysis of the data showed that the multiple-choice test results were most weakly correlated with interview results, whereas the computer-graded written test had the strongest correlation with oral interview results. This suggests that multiple-choice tests are not the best way to evaluate

system: the two-dimensional gas that appears at the interface between the insulators SrTiO₃ and LaAlO₃. Tunneling into the layer while modulating its carrier density by applying a gate voltage, the authors observed an energy gap in the DOS that behaved in a similar manner to the pseudogap in high- T_c copper oxide superconductors. Like the pseudogap, a gap in the DOS grows monotonically with carrier depletion and persists to temperatures far above the T_c . This similarity is surprising given the differences between the electronic structures of the two systems. What they do have in common, however, is dimensionality. Although copper oxides are three-dimensional compounds, they are layered, and most of the action happens in the two-dimensional planes. The authors thus suggest that the copper oxides' characteristic phase diagram might be related to the nature of two-dimensional superconductivity. — JS

Nature **502**, 528 (2013).