



increase substantially in the next few decades. Groundwater responds more slowly to climate variability than surface water and is therefore important, for example, in the event of drought. Yet information about groundwater resources on the African continent is woefully incomplete. MacDonald *et al.* report quantitative maps of groundwater storage and potential groundwater yields in Africa. To do so, they collated and reviewed existing hydrogeological maps, aquifer studies, and borehole data from across the continent. The estimated overall volume of groundwater, 0.66 million km³, far exceeds that of the annual renewable freshwater resources and of lake waters. However, groundwater distribution is uneven across the continent. Most of the large groundwater stores that would be able to accommodate high-yielding boreholes are located in northern Africa and are often far away from population centers. The authors also caution that groundwater resources must be managed carefully to avoid degradation and depletion. — JFU

Environ. Res. Lett. **7**, 024009 (2012).

BIOCHEMISTRY

A (PEP)py Response

Phosphoenolpyruvate (PEP), the final intermediate of glycolysis, is a central cellular metabolite. Besides its conversion to pyruvate by pyruvate kinase during glycolysis, in prokaryotes it is also the substrate for glucose phosphorylation (required for the import of glucose), and in some bacteria it is also converted to oxaloacetate by PEP carboxylase—an anapleurotic reaction that replenishes an intermediate in the tricarboxylic acid (TCA) cycle. Xu *et al.* found that as expected, depriving *Escherichia coli* of glucose resulted in a decrease in early glycolysis intermediates such as fructose-1,6,-biphosphate (FBP), but also observed the remarkable finding seen by others, that PEP increased at least 10-fold. A metabolic flux analysis showed that this was likely due to almost complete inhibition of PEP carboxylase. Although FBP is a known PEP carboxylase activator, on the basis of previously

measured effects, the change in FBP concentration would not explain the reduction in PEP carboxylase activity. Rather, acetyl-CoA and aspartate enhanced the effect of FBP on PEP carboxylase

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GENETICS

The Evolution of X and Y

Although most flowering plants are hermaphroditic, having male and female function within a single flower, a few have shifted sexual function into separate male and female individuals, a condition known as dioecy. White campion (*Silene latifolia*) is a dioecious plant with XY chromosomes that determine the plant's sex; however, whether they arose through a similar evolutionary process as the mammalian XY system is unclear. Muyle *et al.* sequenced the transcriptome of *S. latifolia* and found that genes on the Y chromosome show significantly less gene expression than those from the X. Examination of sex-linked transcripts from male and female plants indicated that *S. latifolia* is in the process of evolving dosage compensation for the X chromosome because of the degeneration of the Y, analogous to that of many animals, including humans. Furthermore, given the evolutionary youthfulness of this system (<10 million years compared to 150 million years for mammals), these findings suggest that dosage compensation is a relatively early process in the evolution of sex chromosomes. — LMZ

PLoS Biol. **10**, e1001308 (2012).

BIOMEDICINE

Mediating Metabolism

Heart disease is a common complication of obesity-associated metabolic disorders such as type 2 diabetes, but the molecular mechanisms underlying this link are not fully understood. Much research has focused on the notion that specific metabolic aberrations such as lipid accumulation compromise the heart's structure and function. A new study suggests that the situation is more complex: Rather than simply being an organ targeted by metabolic dysfunction, the heart itself may regulate whole-body metabolism. Grueter *et al.* observed improved metabolic features in transgenic mice with cardiac-specific overexpression of MED13, a regulatory subunit of Mediator (a protein complex bridging transcription factors and RNA polymerase). These mice were resistant to diet-induced obesity and metabolic syndrome because of an

increase in energy expenditure, and they showed altered expression of genes controlled by the thyroid hormone receptor. Interestingly, cardiac expression of MED13 is negatively regulated by miR-208a, a microRNA encoded by an intron of a cardiac-specific myosin gene. Pharmacological inhibition of miR-208a in wild-type mice on a high-fat diet slowed both weight gain and the development of glucose intolerance. — PAK

Cell **149**, 671 (2012).

HYDROLOGY

Groundwater Maps for Africa

Access to safe drinking water and to water resources for agriculture is essential for African development; water use on the continent is likely to



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activity, and modeling showed that this could explain the observed PEP accumulation. Metabolic data obtained with an FBP-insensitive mutant suggested that PEP accumulation is required for normal resumption of growth upon reexposure to glucose. Thus, the anaplerotic reaction is switched on and off through sensitive allosteric regulation of PEP carboxylase, enabling bacteria to rapidly adapt to changing environmental conditions. — VV

Nat. Chem. Biol. **8**, 10.1038/nchembio.941 (2012).

EDUCATION

All in Our Heads?

Math anxiety is a familiar ailment to many adults; however, little is known regarding its neurodevelopmental basis. To investigate this, Young *et al.* used a scale for evaluating math anxiety in adults to assess math anxiety in 7- to 9-year-old children. In a separate session, functional MRI data were obtained from these children while they determined whether



addition and subtraction problems were done correctly. Math anxiety was found to associate with hyperactivity in the amygdala, a region of the brain involved in processing negative emotions, and with reduced activity in prefrontal cortex regions implicated in mathematical reasoning. Furthermore, connectivity between the amygdala and prefrontal cortex regions involved in emotional regulation was elevated in children experiencing math anxiety. These findings confirm math anxiety as a legitimate type of stimulus- and situation-specific anxiety. Future studies should investigate whether it is possible to design treatment strategies based on successful therapies for other phobias that result from aberrant activity in the amygdale. Future work should also focus on whether studies like these can provide information on how problem-solving and reasoning are influenced by math anxiety. — MM

Psychol. Sci. **23**, 10.1177/0956797611429134 (2012).

APPLIED PHYSICS

Optical Origami

The Japanese art of origami, in which paper is meticulously folded into a wide range of intricate three-dimensional shapes, also lends itself to myriad applications in engineering; examples include the possibility of efficient flat-pack transportation of “pop-up” accommodation buildings in disaster-struck areas, and the preparation of expandable stents that allow for minimally invasive keyhole surgery. The folding itself can be induced by a number of stimuli depending on the materials involved, with electrical, magnetic, chemical, or mechanical stimuli having been demonstrated. Ryu *et al.* now show that light can also be used to fold photo-responsive polymers into intricate shapes. The light absorbed in the polymer film induces a photochemical reaction that relaxes the stress. By using a pattern of photomasks, they could localise the regions of stress relaxation to form hinges that then allowed the film to fold into a prescribed shape. The authors discuss the flexibility of blending in other molecules into the polymer that would provide the structure with advanced functionality. — ISO

Appl. Phys. Lett. **100**, 161908 (2012).

CLIMATE SCIENCE

The Climate of the Apes

The middle Miocene, around 15 million years ago, was a crucial time in the evolution of apes and eventually humans. Apes had recently evolved, and as climate warmed, their range expanded greatly, across most of Eurasia, leading to further diversification. One view is that some of these Eurasian apes eventually recolonized Africa as climate later cooled, although the fossil record remains sparse from this period. Hamon *et al.* explored the climatic conditions that led to this period of warmth in the Miocene and particularly that were favorable for the expansion of subtropical forests that the apes depended on. Using a global climate model, they concluded that the range of forests would be greatest when atmospheric CO₂ levels were between about 560 and 700 ppmv. The East Antarctica Ice Sheet, which is thought to have begun to form by the middle Miocene as the overall Cenozoic climate was cooling, but not uniformly, was about 25% of its modern extent. Both conditions are needed to increase precipitation in Europe at that time. Further decreases in atmospheric CO₂ levels and the expansion of ice led to the reduction of forests later in the Miocene. — BH

Geology 10.1130/G32990.1 (2012).

22
minutes and
58 seconds
of video
on accelerated
mass loss
from Antarctica's
ice shelves.

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