

Gill lamellae of the cichlid fish.

PHYSIOLOGY

Gill-on-a-chip illuminates evolution

Fish gills are natural microfluidic devices that evolution has optimized to extract oxygen from water. The spacing between the lamellae, the tiny protrusions that cover gill filaments, varies little between fish of wildly different sizes, which suggests that this spacing is important for gill function. To test this, Park *et al.* developed a mathematical model for oxygen transfer across lamellae. Indeed, they found, lamellae spacing is critical for gill function, as is the way fish pump water through their gills. The researchers then tested their model against an artificial gill—a microfluidic chip where oxygen diffuses across synthetic membranes. When they varied the distance between the membranes, the artificial gill extracted the most oxygen with membrane spacing similar to that of lamellae in fish gills. — GR

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1403621111 (2014).

pathways by combining genetics with metabolomics, the study of small molecules (aka metabolites) in biological systems. They identified 145 genetic loci, 84 previously unidentified, that they predicted would affect a wide range of biological functions. These 145 genetic loci were connected in a network to 400 biochemically relevant blood metabolites, forming an atlas of metabolites in the blood. Identifying these genetic variants that affect blood metabolites helps us gain a better understanding of human biology and potential treatments for disease. — LMZ

Nat. Genet. 10.1038/ng.2982 (2014).

PALEOCLIMATE

Seasonal rainfall and Indonesian vegetation

Both gradual and abrupt changes in rainfall—similar in many ways to those happening today—had dramatic effects on the vegetation of Indonesia over the past 25,000 years. Dubois *et al.* report that variations in the seasonality of rainfall there, and the resulting water stress during the dry season, caused large swings in the balance between grasslands and forests. Vegetation type depended more on the depth of seasonal dry cycles than on the

amount of annual rainfall, they found. These results, obtained by analyzing the stable isotopic composition of fatty acids produced by vascular plants and preserved in marine sediments, reflect the importance of the monsoonal precipitation that's so vital to Indonesian agriculture and human well-being. — HJS

Nat. Geosci. 10.1038/ngeo2182 (2014).

GREEN CHEMISTRY

Making plastic bottles more renewable

All of the components of the plastic used to make clear soda bottles now can be supplied by renewable materials. The polymer polyethylene terephthalate is made from two monomers, ethylene and terephthalic acid (PTA). Chemists already can make ethylene from ethanol produced from plants, but PTA is made by oxidizing *p*-xylene, a petroleum derivative. Pachero and Davis show that a chemical derived on a commercial scale from biomass, 5-hydroxymethylfurfural (HMF), can be converted to PTA with the help of a

catalyst called tin-beta. This process opens a route to more environmentally friendly plastic bottle manufacture. — PDS

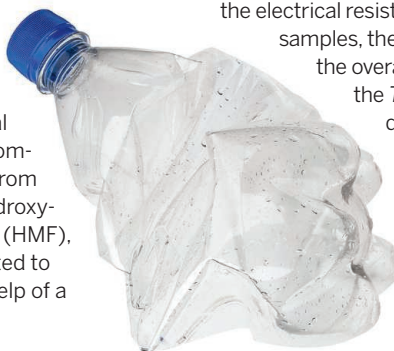
Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.1408345111 (2014).

PHYSICS

A second hump in a superconducting dome

Pure strontium titanate (SrTiO_3) does not conduct electricity, but adding tiny amounts of impurities can turn it into a perfect conductor: a superconductor. Lin *et al.* found that, for a particular concentration of extra electrons introduced by adding Nb to the samples, the temperature at which SrTiO_3 becomes superconducting (T_c) has a maximum. This concentration coincides with the state when the electrons have filled up one energy band of the material and are just starting to fill up another. By measuring the electrical resistivity of the samples, they found that the overall shape of the T_c dependence on the electron concentration

Plastic bottle made from all-green stock.



was a two-humped dome. Unlike superconducting domes in other materials, the base of the dome was quite broad and spanned a range of over three orders of magnitude of carrier concentration. — JS

Phys. Rev. Lett. **112**, 207002 (2014).

POLAR ECOLOGY

Iceberg scours alter seafloor diversity

The ocean seabed is a patchwork quilt of colors and species. But along the West Antarctic Peninsula, increased iceberg activity—due to climate change and fewer days of frozen seas—is reducing sea floor biodiversity. Icebergs scouring the sea floor temporarily destroy habitat; different species recover at different rates. Barnes *et al.* examined spatial distribution, diversity, interactions between and within species, and ice scour hits near Rothera Research Station from 1997 to 2013. One species, *Fenestulina rugula*, was quickest to recover; it now dominates, and is involved in, 96% of all interactions. Such reduced diversity could mean more vulnerability to invasive species. — CG

Curr. Biol. 10.1016/j.cub.2014.04.040 (2014).