

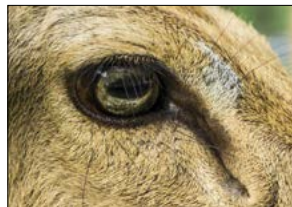
# Sciencewatch

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## Predator vs prey: how pupil shapes help

While human pupils are round, many animals have elongated pupils, with vertical elongation typical for ambush predators and horizontal elongation for animals that are likely to be prey. Now, Martin Banks of the University of California, Berkeley, and colleagues have an explanation. The key is astigmatism, which predators take advantage of to help catch prey, while prey use it to avoid being caught.

Predators' pupils give them a better ability to judge distance without moving their heads, which might give them away to prey. The pupils of prey give up some vertical focus in exchange for a more panoramic view, while reducing the amount of light from above and



*Pupils in predator, left, and prey. (Image credits: S Pritchard, left, and Bonmoovol Dreamstime.com.)*

below. One simple observation that supports the theory, which anyone can make at a zoo or a farm, is that grazing animals have eyes that rotate 50° or more as they lower their heads to graze, keeping the pupils parallel to the ground. (Human eyes can rotate only a

few degrees.) However, more work remains to be done, including explaining why cuttlefish have W-shaped pupils.

### ● Further reading

MS Banks *et al.* 2015 *Sci. Adv.* **1** e1500391.

## Opioids from yeast

While predicted to come soon, this result has come sooner than expected: complete biosynthesis of opioids in yeast. Christina Smolke of Stanford University and colleagues engineered yeast to produce the opioids thebaine and hydrocodone, starting from sugar. The work combined enzyme discovery and engineering with pathway and strain optimization. Twenty-one enzyme activities from plants, mammals, bacteria and the yeast itself were needed for thebaine and 23 for hydrocodone. While not yet suited for large-scale production, this proof-of-principle shows that it may eventually be as easy to make opioids as it is to brew beer.

### ● Further reading

S Galanie *et al.* 2015 *Science* DOI: 10.1126/science.aac9373.

## Surprising superconductor

While the Bardeen–Cooper–Schrieffer (BCS) theory of superconductivity sets no theoretical bound on how high  $T_c$  can be, the highest up to now has been 133 K at ambient pressure and 164 K at high pressure in copper oxide. The new surprise is in sulphur hydride, where a  $T_c$  of 80 K had been predicted. Alexander Drozdov of the Max Planck Institute for Chemistry in Mainz and colleagues have found that this material becomes metallic at a pressure of 90 GPa with a  $T_c$  of an amazing 203 K. Isotope-shift effects are consistent with BCS theory, and the discovery raises hopes of finding a room-temperature superconductor.

### ● Further reading

AP Drozdov *et al.* 2015 *Nature* DOI:10.1038/nature14964.

## High-temperature dielectrics

Dielectric capacitors – the simple ones described in a first course on electromagnetism – would find more uses if they could tolerate temperatures above 150 °C and achieve a larger stored energy density. Polymers have long been a popular choice for dielectrics because of their low cost and ease of manufacture, but the “Moss rule” links increases in polarizability to a lower breakdown voltage for homogeneous polymers. This makes high energy densities seem unlikely, moreover polymers tend to melt or break down at high temperatures.

Qi Li and colleagues at Pennsylvania State University have found that composite polymers can bend or break the Moss rule and tolerate much higher temperatures than had been previously possible. They blend boron-nitride nanosheets (BNNS) with divinyltetramethylsiloxy-bis(benzocyclobutene) (BCB) and then react the BCB molecules to produce nanocomposites of BNNS in polymeric cross-linked BCB. The result is a dielectric with record properties including a Weibull breakdown strength of 403 MV/m and an energy density of 1.8 J/cm<sup>3</sup> at 250 °C. Added bonuses include their being orders of magnitude less conductive than other polymers and their ability to tolerate bending.

### ● Further reading

Q Li *et al.* 2015 *Nature* **523** 576.

## Venomous frogs



*Brazil's yellow-skinned tree frog, *Corythomantis greeningi*, has venom twice as toxic as a pit viper. (Image credit: Jared *et al.* 2015.)*

Many frogs are known to be poisonous, which is to say that they have noxious or toxic substances in their skin that afford them passive protection against predators, but they had not been known to inject venom in the way that many snakes and some reptiles do. Now, Edmund Brodie at Utah State University and colleagues have found the first frogs that can actively deliver poison.

The creatures are two species of Brazilian tree frog that have spiny heads with which they can jab a target – using the venomous-frog version of a “head butt” – effectively injecting venom that for one is twice, and the other 25 times, as lethal as that of deadly *Bothrops* pit vipers (also from Brazil). With these first examples of venomous amphibians, the question now is how many more are there?

### ● Further reading

C Jared *et al.* 2015 *Current Biology* **25** 2166.

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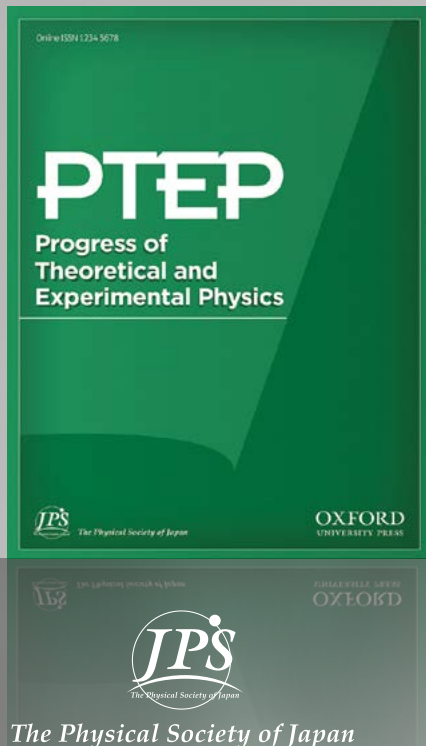
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