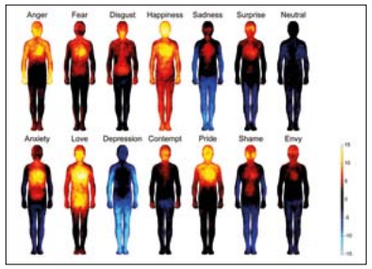
Sciencewatch

Compiled by John Swain, Northeastern University

Finnish team maps emotions

Common speech has many expressions – e.g. "cold feet" or "a broken heart" – that associate emotions with parts of the body. In a remarkable study, Lauri Nummenmaa of Aalto University in Finland and colleagues asked online participants to report their bodily sensations by colouring human silhouettes in response to emotional words, stories, movies or facial expressions. The responses were digitized on a map of a body represented by 50,634 data points. The survey was conducted as five experiments on 701 participants.

The analysis revealed statistically separable body maps associated with



The patterns found for basic (top) and nonbasic (bottom) emotions associated with words. The body maps show regions where activation increased (warm colours) or decreased (cool colours) when feeling each emotion.

different emotions, from anger and anxiety to sadness and surprise. The results were highly concordant across West European and East Asian samples, suggesting that emotions are felt in the body in universal ways.

To participate in the ongoing online experiment, visit http://becs.aalto.fi/~lnummen/participate.htm.

Further reading
L Nummenmaa *et al.* 2014 *PNAS* **111** 646.

Deep water

Jules Verne imagined an ocean deep underground in his 1864 novel Journey to the Centre of the Earth and it turns out that, in a sense, he might have been right. Graham Pearson of the University of Alberta in Edmonton and colleagues found a sample of ringwoodite – a mineral from the Earth's mantle transition zone, which lies 410–660 km below the surface – in a diamond from Juína in Brazil, which must have been driven upwards rapidly, possibly by a volcanic explosion. If this inclusion (about 1% by weight) is representative of the transition zone, then its high water content indicates that this zone contains 1.4×10^{21} kg, or about the same as all the world's oceans combined.

Further reading
D G Pearson *et al.* 2014 *Nature* **507** 221.

Smarter in orange

Melanopsin, a light-sensitive protein in the retina, seems to play a role in the cognitive function of the brain. Sarah Chellappa of the University of Liège and colleagues used functional magnetic resonance imaging to look at brain activity in 16 people while they performed cognitive tests after exposure to different colours of light for 10 minutes followed by 70 minutes of darkness. The tests were done under green light.

People exposed to orange light had more activity in the prefrontal cortex, which is involved in higher brain function. This provides the best evidence so far that melanopsin, which plays no role in vision but absorbs orange-red light, affects mental performance and contributes to a unique "photic memory".

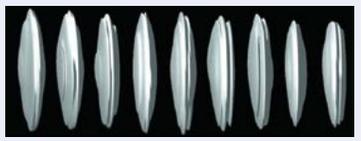
Further reading
S L Chellappa *et al.* 2014 *PNAS Early Edition*, www.pnas.org/cgi/doi/10.1073/pnas.1320005111.

Seeing the vacuum

The idea of energy in the vacuum of quantum field theory is familiar, at least to physicists. Now it has been imaged in 3D for the first time. Moonjoo Lee of Seoul National University and colleagues used single barium atoms as a spontaneous-emission probe for the vacuum energy density inside high-Q microcavities that were built as a 2D array of 170 nm holes in a 75-nm-thick silicon-nitride membrane.

Excited atoms sent into a cavity emitted a photon with a probability that was proportional to the vacuum field-intensity at the cavity's position. A measurement of transit-time broadening then gave the distribution of the vacuum energy in the transverse directions, while the spectrum of the emitted photons gave it along the atom's flight path. This allowed for the construction of a full 3D image of the vacuum energy density in the cavity. The team could also measure the amplitude of the vacuum field in the cavity, which was as large as 1 V/cm, therefore putting a value on the emptiness of "empty space".

Further reading
M Lee *et al.* 2014 *Nature Communications* **5** 3441.



The 3D image made of the cavity vacuum-field intensity.

Nanotubes improve photosynthesis

Single-walled carbon nanotubes (SWNTs) can increase photosynthesis in chloroplasts – the parts of plant cells where the process takes place. Michael Strano at Massachusetts Institute of Technology and colleagues have found that SWNTs passively transport to, and irreversibly localize in, the lipid envelopes of extracted choloroplasts. They can absorb light over a wider range than chlorophyll, forming excitons that can feed electrons into the photosynthetic machinery, therefore vastly boosting its efficiency.

Poly(acrylic acid)-nanoceria or SWNT-nanoceria complexes were also incorporated to reduce levels of reactive oxygen species. SWNTs can also be turned into chemical sensors, making chloroplasts not only more efficient but also able to act as photonic chemical sensors. They can even be incorporated into complete living plants.

Further reading
J P Giraldo *et al.* 2014 *Nature Materials* **13** 400.

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