



BEHAVIOR

Crabbing in the Chesapeake

As the state crustacean of Maryland, the blue crab (*Callinectes sapidus*) is dear to the hearts and stomachs (and wallets) of many residents. The commercial crabbing season opened just a few weeks ago, and pessimistic forecasts for the size of this year's harvest have led to draft proposals that more stringent protection of adult females be implemented. Kamio *et al.* describe a laboratory study of the courtship behavior of the male blue crab and interpret it as an adaptation to their environment. They observed that upon being presented with an inaccessible female (corralled by plastic mesh), male crabs spread their chelae (the first pair of legs in a decapod crustacean, commonly referred to as claws in crabs and lobsters) and elevated their swimming legs (the last pair of legs) into a dorso-medial position. When in this stance, the males paddled their swimming legs circularly and 180° out of phase. Particle imaging velocimetry revealed a forward-directed flow of water traveling at an average speed of 3 cm s⁻¹. The authors suggest that the marshy habitat of the Chesapeake Bay allows female crabs to avoid predators while signaling their presence by pheromone; the males have adopted courtship paddling as a means of wafting their own chemical lures toward unseen females in order to coax them into open water. — GJC

J. Exp. Biol. **211**, 1243 (2008).

PHYSICS

Probing Non-Standard Charges

The Standard Model of particle physics describes three of the four fundamental forces, detailing the strengths of interactions among the protons, electrons, and neutrons that make up atoms, as well as the family of quarks that in turn make up these particles. The framework gives rise to charge quantization, as measured in discrete units of electron charge e , and also the charge neutrality of atoms. However, the violation of certain symmetries that describe the underlying physics of all these forces—as is evident from the dominance of matter over antimatter in the universe—indicates that there is something happening beyond the Standard Model. Much theoretical and experimental

effort is directed toward exploring this regime, with some work suggesting that the notion of charge quantization and charge neutrality should be abandoned. In efforts to detect the minuscule charges that could explain the broken symmetries, Arvanitaki *et al.* describe a sensitive method for detecting charge on an atom based on the interference of atom waves. They argue that during splitting and recombination of a condensed cloud of rubidium atoms, a departure from charge neutrality of as little as 10⁻²⁸ e should be detectable as a phase shift in the interfering atom waves. This cold atom approach may provide an alternate route to looking beyond the Standard Model. — ISO

Phys. Rev. Lett. **100**, 120407 (2008).

CHEMISTRY

Taking the Heat

Ceramics are often prepared by heating structurally well-defined molecular or polymeric precursors to very high temperatures; in the process, peripheral hydrogen and halide (X) atoms are expelled as HX gases, and the severed bonds of the remaining solid rearrange into a rigid network that lends the material stability. When prepared in this manner, the amorphous ceramic SiBNC shows impressive resistance against thermal or oxidative degradation. Somewhat surprising is the key contribution of carbon, which traditionally segregates from nitrogen during pyrolysis. Sehleier *et al.* monitored the fate of the carbon precursor (methylamine) during the synthesis of this material, and found strong evidence that in this case, C-N bonds remain intact even at 1400°C. Their study relied on double isotopic labeling (¹³C and ¹⁵N) of the precursor and subsequent analysis of the ceramic by solid-state nuclear magnetic resonance spectroscopy. Application of the rotational echo double-resonance technique revealed the distribution of bonding distances between the two labeled nuclei and suggested some degree of multiple bonding through π overlap. — JSY

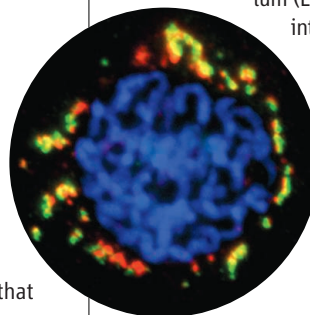
Angew. Chem. Int. Ed. **47**, 10.1002/anie.200705786 (2008).

CELL BIOLOGY

Divide and Rule

Intracellular cholesterol metabolism is controlled by sterol regulatory element-binding proteins (SREBPs), which are stored in an inactive membrane-bound form within the endoplasmic reticulum (ER) compartment via an

interaction with ER-restricted sterol sensors. When the level of cellular sterols is depleted, the sensors let go of the SREBPs, which are then trans-



Colocalization (yellow) of S1P in the Golgi.

ported to the Golgi complex, where they are cleaved by site-1 protease (S1P). This cleavage liberates the transcription factor domain from the membrane, and it then enters the nucleus and activates the expression of genes involved in sterol and phospholipid metabolism. During interphase, like many Golgi proteins, S1P cycles

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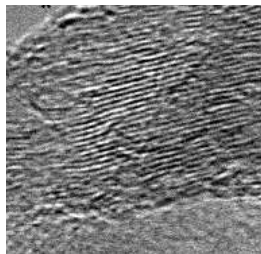
between the ER and the Golgi complex, and when ER and Golgi membranes merge, for example after treatment with the drug brefeldin A, SREBP cleavage is activated. During mitosis, the Golgi disassembles, and some evidence suggests that a fraction of the Golgi and ER membranes merge; so how then can the cell avoid inadvertently activating SREBPs? Bartz *et al.* show that during mitosis, S1P and SREBP reside in separate compartments: SREBP remains trapped in the ER, and S1P is sequestered in the clustered remnants of the disassembled Golgi. — SMH

EMBO J. 27, 948 (2008).

CHEMISTRY

Epoxide Exfoliants

The graphite form of carbon consists of strongly bonded two-dimensional sheets stacked relatively loosely on top of each other. One approach for



separating graphite into these individual graphene sheets or multilayers—a morphology with broadly useful emerging electronic properties—involves

preliminary oxidization. Solid-state nuclear magnetic resonance studies suggested that the major oxidation product is an epoxide, similar to the product formed upon oxidizing single-walled carbon nanotubes. Chattopadhyay *et al.* have obtained Raman spectral evidence for epoxide formation on graphite, and could furthermore quantify the extent of the reaction by methyltri-

oxorhenium-catalyzed transfer of the oxygen atoms to triphenylphosphine, a reaction pathway specific to epoxides. They also imaged functionalization of individual flakes using high-resolution transmission electron microscopy and scanning tunneling microscopy. The reduced and oxidized forms showed similar basal plane roughness, which suggests that epoxidation occurs mainly at edge sites. — PDS

J. Am. Chem. Soc. 130, 10.1021/ja711063f (2008).

GENETICS

Y not X?

In mammals, a disproportionately high number of genes from the X chromosome have been moved, via transposable elements, to the autosomes. By examining all retrotransposed genes in three placental and one marsupial mammal, Potrzebowski *et al.* have found that only a subset of these genes, the majority originating from the X chromosome, have retained their functions.

In mice, most of the relocated genes originating from the X chromosome are specifically expressed in the testes, while those originating from other chromosomes are expressed broadly. The movement is due to a process known as meiotic sex chromosome inactivation, where replicated genes take over the function of their X-linked parents, which are silenced during meiosis. On the basis of these results, the authors hypothesize that the origin of these meiotic retrogenes dates to the divergence of the placental and marsupial mammals. Because meiotic X inactivation reflects the differentiation of the X and Y chromosomes, these chromosomes may be younger than previously suggested. — LMZ

PLoS Biol. 6, e80 (2008).

Science Signaling



<< Sirtuin to Become Astrocytes

Although neural progenitor cells (NPCs) can differentiate into neurons, astrocytes, or oligodendrocytes, brain injury stimulates the production of astrocytes in preference to neurons. Noting that some neurological diseases are associated with inflammation and oxidative conditions, Prozorovski *et al.* investigated the effects of redox state on NPC differentiation. The fraction of cultured NPCs that differentiated into astrocytes was larger under oxidative conditions, whereas the fraction that differentiated into neurons was smaller. Conversely, NPCs cultured under reducing conditions were more likely to differentiate into neurons and less likely to differentiate into astrocytes. The amount of the histone deacetylase Sirtuin1 (Sirt1) was increased in NPCs cultured under oxidative conditions, and *Sirt1* knockdown blocked the effects of oxidation on differentiation. Oxidative conditions promoted the association of Sirt1 with the transcription factor Hes1 and decreased the expression of *Mash1*, which encodes a neurogenic transcription factor. Mouse pups injected with a pro-oxidant showed an increase in Sirt1 in a germinal region of the brain, along with a decrease in neurogenesis; in utero knockdown of *Sirt1* increased neurogenesis in such oxidant-treated pups. Thus, the authors conclude that nontoxic manipulation of redox conditions can influence NPC fate, and that Sirt1 plays a critical role. — EMA

Nat. Cell Biol. 10, 385 (2008).