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EVOLUTION

A Smart Merger

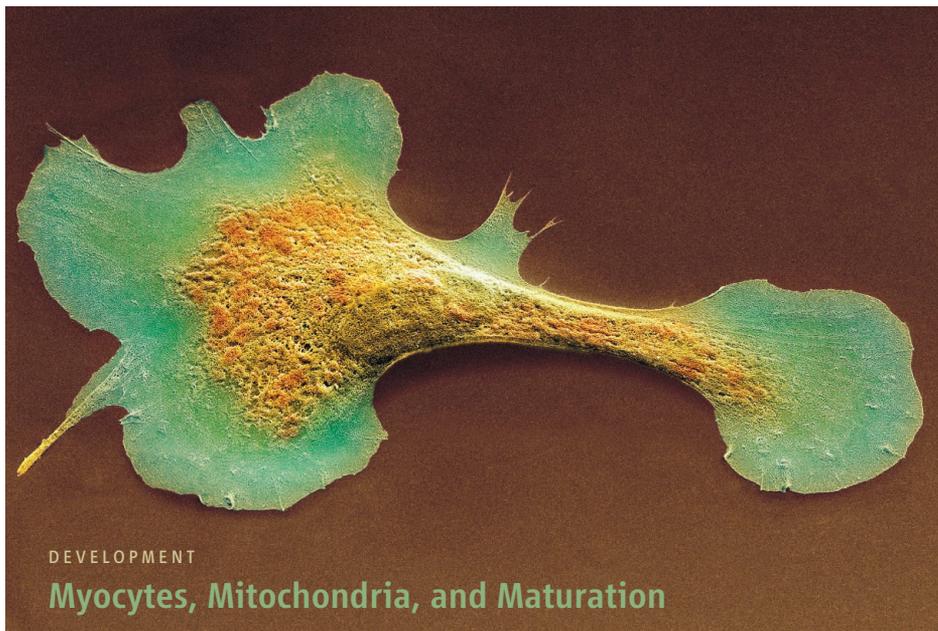
The identification of factors that have driven the evolution of cognition not just between humans and nonhumans, but across taxa, is of interest to comparative psychologists. This interest has arisen because of the recognition that high-level cognitive function is not limited to primate lineages and that cognition, like many other traits, is probably shaped by selection imposed by ecological and environmental demands. MacClearn *et al.* now propose that the merger of the fields of comparative psychology and phylogenetics will greatly improve our ability to understand the forces that drive cognitive evolution. By using examples of comparative data on inhibitory function, a measure of cognitive ability, they highlight how the comparative phylogenetic method will expand our understanding by testing for correlations between cognition and specific life history, morphological, or social ecological traits; measuring how well phylogenetic relatedness predicts similarity in cognitive function; and estimating ancestral levels of cognitive function based on measured levels in extant related taxa. This approach will also allow for an improved ability to select appropriate pairs of species for comparison. The new level of analysis afforded by the merger of these two fields will enable a move away from simple "cognitive model" species and will provide insight into how cognitive abilities evolved and operate in a wide array of species, perhaps even our own. — SNV

Anim. Cogn. **14**, 10.1007/s10071-011-0448-8 (2011).

MATERIALS SCIENCE

Time for Change

Phase-change materials, such as $\text{Ge}_2\text{Sb}_2\text{Te}_5$ (GST), show exceptionally fast phase transitions, which renders them useful for optical data storage and nonvolatile memory applications. *Ab initio* molecular dynamics simulations can explore the early stages of nucleation and crystallization in such materials. Lee and Elliott used models with 180 atoms that were held at constant volume to simulate capped films and annealed from a quenched glassy state. They defined the smallest structural element in the metastable rocksalt phase of GST as a fourfold ring (or square), six of which are required to make a cube. Both these elements are observed in the amorphous phases as transient structures. By tracking the number of rings and cubes, they identified four stages in the crystallization process, with a critical nucleus size of 5 to 10 GST



DEVELOPMENT

Myocytes, Mitochondria, and Maturation

Understanding the factors and events required for normal heart development will hopefully provide insight into how to treat heart disease and other cardiac abnormalities. Mitochondrial function is essential in cardiac cells, with mitochondria transitioning from an immature to mature state in the embryo. How this occurs, however, is not well understood. During early embryonic development, Hom *et al.* find that mitochondria alter their length, network complexity, and area, becoming more mature. This corresponds with a decrease in reactive oxygen species in cardiomyocytes and their differentiation. Genetic and pharmacological inhibition showed that these changes are probably the result of the closure of mitochondrial permeability transition pores (mPTPs). mPTP closure increased ATP production needed for myocyte function and drove myocyte differentiation through redox signaling. Thus, the maturation of mitochondria signals cardiomyocyte differentiation. — BAP

Dev. Cell **21**, 469 (2011).

cubes. At the interface between the nucleus and the amorphous phase, they observed a series of quasi-ordered rings, an arrangement facilitated by the near 90° bond angles found in GST. They propose that it is the similarity between the bonds found in the amorphous state and the distorted rocksalt structure, common to most phase-change materials, that allows such rapid crystallization. — MSL

Phys. Rev. Lett. **107**, 145702 (2011).

APPLIED PHYSICS

TI Tuning

On the list of exotic materials on the verge of becoming technologically useful, topological insulators (TIs) rank high. They possess a favorable electronic surface state in which a certain type of scattering is suppressed because of symmetry; however, in almost all materials identified to date, this surface state is barely

noticeable in comparison with the dominant but conventionally conducting bulk state. Chemical doping and electrical gating have been used to control the conductivity of the bulk state in binary TIs such as Bi_2Se_3 . With the same aim, Kong *et al.* vary the Bi and Sb content in thin nanoplates of a ternary compound ($\text{Bi}_x\text{Sb}_{1-x}\text{Te}_3$ between the two extremes, Bi_2Te_3 and Sb_2Te_3 , which are both TIs. They find that the TI character is maintained across the doping range, while the carrier density of the bulk state varies dramatically in magnitude, reaching a minimum at equal amounts of Bi and Sb ($x = 0.5$). For this optimal composition and at an optimal thickness of the plate, applying a gate voltage leads to pronounced tuning of the carrier density and type, going from electron- to hole-dominated transport, similar to what has been observed in graphene. — JS

Nat. Nanotechnol. 10.1038/NNANO.2011.172 (2011).