EDITED BY KRISTEN MUELLER AND JAKE YESTON

ASTROPHYSICS

A Test to See in the Dark

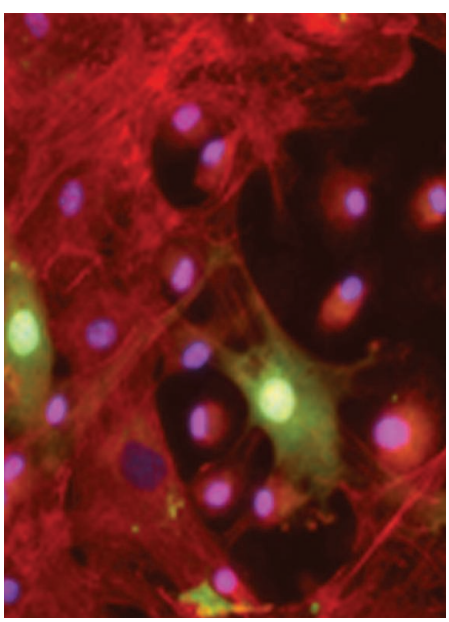
According to current models of structure formation in the universe, large galaxies, like our Milky Way, formed from the merging of many smaller systems. The models predict that a large number of small satellite galaxies should exist in our galaxy's vicinity, but this prediction does not match the observations. However, some of these small galaxies may be too difficult to detect, because they may be dominated by dark matter, a mysterious type of matter that does not emit or absorb light but does exert a gravitational pull. The Tidal Analysis method, developed to derive the locations and masses of satellite galaxies from the gravitational perturbations the satellites induce in the gas disk of the primary galaxy, has the potential to reveal satellite galaxies dominated by or composed entirely of dark matter. To demonstrate its validity, Chakrabarti *et al.* applied the Tidal Analysis method to two nearby spiral galaxies, M51 and NGC 1512, which each interact with a known visible companion. The method successfully recovered the masses and locations of the smaller companions; their masses ranging from one-third to one-hundredth of the mass of the primary galaxy. — MJC

Astrophys. J. **743**, 35 (2011).

BIOMEDICINE

Young at Heart

Cell-mediated repair of heart damage is one of the most exciting areas of cardiovascular research but is also one of the most challenging and controversial. One key point of disagreement is which cell type is optimal for such therapy. Among the list of candidates being actively explored are resident cardiac stem cells, embryonic stem cells, induced pluripotent stem cells, and bone marrow–derived cells.



A new candidate cell has emerged from a study of peripartum cardiomyopathy, a form of heart failure that affects a small percentage of pregnant women and is associated with an unusually high rate of spontaneous recovery. Kara *et al*. speculated that fetal or placental cells might contribute to this high recovery rate. Consistent with their hypothesis, they found that when the heart of a pregnant mouse is subjected to acute injury, fetal cells migrate through the blood to the injury site in the maternal heart, where they differentiate into three distinct cell types required for heart repair: endothelial cells, smooth muscle cells, and cardiomyocytes. About 40% of these fetal cells express a marker gene (*Cdx2*) associated with trophoblast stem cells, which form the placenta. This raises the intriguing possibility that readily accessible cells in the placenta might be capable of heart repair. — PAK

Circ. Res. 10.1161/circresaha.111.249037 (2011).

EDUCATION

Calendar Effects

Does the organization of the school calendar affect student learning? Year-round schooling, which distributes school days with short, frequent breaks, is becoming more popular because it is thought to prevent the summer learning loss that occurs under a more traditional school calendar. Using longitudinal data from California public schools over a 9-year period, Graves examined the effect of year-round school calendars on nationally standardized test performance of traditionally disadvantaged students. Analysis showed that year-round calendars, especially multitrack year-round calendars in which the student body is never all in attendance at the same time, have a larger negative impact on the lower end of the distribution of scores, with Hispanics/Latinos and low–socioeconomic status students experiencing a larger fall in performance than the overall population. African American students are more negatively affected than the overall student population with respect to reading. Policy-makers take note: These results present an additional cost of implementing year-round calendars. — MM

Econ. Educ. Rev. **30**, 1281 (2011).

GENETICS

Evolution Illuminates Function

Long noncoding RNAs (lncRNAs) are enigmatic transcripts of the genome defined as noncoding RNAs over 200 bp in length. Although function has been ascribed to some lncRNAs, most are expressed at low levels, and their function, or even whether they have a specific function, is unknown. By examining the transcription of mammalian lncRNAs, focusing on comparisons between lncRNAs found in mice and humans, Managadze *et al.* set out to determine how

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lncRNAs evolve. Calculation of the degree of evolution of these lncRNAs and examination of their relative expression levels revealed a negative correlation between evolutionary rate and expression level. This is similar to what has been observed with protein-coding genes, and like protein-coding genes, nonsynonymous mutations were observed in lncRNAs; that is, mutations predicted to change the amino acid encoded by the codon. No significant correlation was observed between the evolutionary rate of lncRNAs and their predicted secondary structure. On the basis of these findings, the authors conclude that lncRNAs are subject to weak purifying selection and thus are probably functional. — LMZ

Genome Biol. Evol. 10.1093/gbe/evr116 (2011).

CHEMISTRY

Colloidal Construction Kit

Total-synthesis approaches have made an art form of building complex organic molecules from much simpler and smaller pieces, using established rules of reactivity to selectively form specific products at each step. Colloidal particles are often described as "artificial atoms," and hooking them together can produce "artificial molecules" that manifest combinations of useful optical, magnetic, catalytic, and electronic properties. However, synthetic strategies at this scale have largely been limited to fusing two particles together or growing a second particle on the surface of an existing one. Buck *et al.* have now developed a rational and stepwise approach for constructing hybrid nanoparticle oligomers. They started with Fe_3O_4 grown on Pt seed particles. The addition of a gold precursor surprisingly yielded Au-Pt-Fe_3O_4 as the exclusive trimetallic product. Using the same reaction method, the authors produced trimers in which the Au could be replaced by Ag, Ni, or Pd. A fourth component (PbS or mixed-valence Cu_xS) could also be added selectively, and the Au-Pt-Fe_3O_4 trimers could be fused into superdimers or higher-ordered branched nanostructures by heating in the presence of a trace quantity of sulfur. — MSL

Nat. Chem. 10.1038/NCHEM.1195 (2011).

CHEMISTRY

Electrifying Peroxide Synthesis

Traditionally, the purpose of a fuel cell has been to channel chemical energy into electrical energy, and research has focused on optimizing the design to maximize the efficiency of this transformation. In this context, reducing oxygen all the way to water, rather than stopping halfway at hydrogen peroxide, is a central feature. On the other hand, there's a market for hydrogen peroxide, and the current production route is frustratingly indirect (featuring the intermediacy of an organic quinone compound). Jirkovsky *et al.* consider the prospect of using polymer electrolyte fuel cells to cogenerate electricity and hydrogen peroxide. Beginning with the knowledge that certain gold surfaces manifest relatively high selectivity toward the partial reduction reaction, they performed density functional theory calculations to guide optimization. The calculations suggested that isolated Pd or Pt sites on the gold surface should enhance O_2 binding while suppressing scission of the O-O bond, but that adjacent centers of the second metal would promote further reduction to water. These predictions were then borne out in rotating ring-disc electrode measurements: Peroxide selectivity peaked near 95% at a Pd alloying concentration of 8%, but then plummeted as the Pd abundance passed 15% (the threshold for aggregation). — JSY

J. Am. Chem. Soc. **133**, 10.1021/ja206477z (2011).

DEVELOPMENT

Network Development

The circulatory system is made up of complex vascular networks that originate from the association of numerous angiogenic sprouts with motile tip cells and trailing stalk cells. Tip cells contact each other, fuse, and subsequently form an interconnected lumen. Herwig *et al.* now visualize the behavior of single zebrafish endothelial cells during blood vessel fusion (anastomosis) and lumen formation. They used transgenic zebrafish whose endothelial cell junctions of dorsal longitudinal anastomotic vessels were fluorescently labeled to monitor cell movements and cell shape. Anastomosis is seen to result from different morphogenetic mechanisms—one involving cell rearrangement for a process of cord hollowing to generate a multicellular tube or through cell shape changes involving membrane invagination for a unicellular tube. These processes are associated with lumen formation at the position of vessel fusion. In addition, the luminal membrane compartments are polarized apically. With the elegant complexity of the vascular network, perhaps it is not surprising that multiple mechanisms are used to establish blood vessel morphology. — BAP

Curr. Biol. **21**, 1942 (2011).

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