EDITORS' CHOICE
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MOLECULAR BIOLOGY

Variety from Repetitive DNA

Ionizing radiation is harmful to living creatures because it scythes through both strands of genomic DNA, leading to potentially lethal chromosome aberrations. To identify the origin of these aberrations, Argueso et al. have used x-rays to shred the genomes of diploid yeast cells and introduced a staggering ~250 DNA breaks per cell; within 3 hours, most of the shattered chromosomes had been stitched together, with half of the analyzed surviving cells harboring at least one chromosome aberration. A molecular autopsy revealed that most aberrations were associated with a repetitive sequence, the Ty retrotransposon, a selfish DNA element scattered throughout the yeast genome, and that the aberrations appeared to have arisen via failed DNA repair attempts. Normally, homologous chromosomes in a diploid cell allow one chromosome to act as a template for the repair of the other. For breaks that occur in or near Ty elements, rather than the homologous element being used, any of the Ty elements in the yeast genome might be selected, mixing chromosomal material and making repetitive DNA a driving force for genomic variation. — GR


PSYCHOLOGY

The Cost of Equal Opportunity

Lotteries have become a widespread means of generating billions of dollars for state treasuries in the United States. The low chances of winning life-style-altering prizes are prominently posted, yet many people, especially those in low-income brackets, pay $1 in order to receive only 50¢ in return, on average. What motivates such financially maladaptive behavior? Haisley et al. suggest that one contributory factor is the psychological desire to improve one’s standing in a social hierarchy defined by one’s friends and neighbors. When bus passengers earning $20,000 annually were subjected to a subtle manipulation (in the form of answering a survey), those induced to feel that their income was below average purchased twice as many scratch-off tickets as those placed at the midpoint of an income ladder. One reason why playing the lottery holds a differential appeal for lower-income individuals (and why they buy into this dream) is implicit in the winning chances, which though small, apply equally to all players, regardless of socioeconomic status. In a second field experiment, priming subjects with considerations of opportunity in the context of employment, elections, or gambling was also sufficient to induce them to purchase a greater number of lottery tickets. — GJC


GEOLOGY

Colder than Expected

Extensive glaciations on Earth have been rare since the Cambrian explosion of life, about 550 million years ago. Earth’s recent Ice Age spans only the last 2.5 million years when extensive continental ice sheets grew in the Northern Hemisphere. A comparable glaciation seems to have occurred during the Late Carboniferous and Early Permian Periods, about 300 million years ago, when ice sheets covered regions toward the South Pole of a large single supercontinent (across what is now southern Africa, Australia, Antarctica, South America, and India). Soreghan et al. discuss evidence that some glaciation may have occurred even at tropical latitudes during this time. An exhumed low-elevation valley in the western United States has a “U” shape consistent with glacial formation and contains sediments that date to 300 million years ago.

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this time and are consistent with glacial deposition. Thick windblown dust deposits derived from basement rocks, common around the large Pleistocene ice sheets, are common in rocks in southwestern North America. These observations, if indicative of persistent ice at low latitudes, pose a challenge to climate models even if atmospheric CO₂ levels were low at this time, as is thought. — BH

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**CLIMATE SCIENCE**

**Cause of Death**

During the mass extinction event that occurred 200 million years ago, at the end of the Triassic Period, around half of all extant species vanished. In the marine realm, about 20% of all families and more than 90% of the genera in some groups of organisms disappeared. What caused that catastrophe? One hypothesis is that elevated atmospheric CO₂ was the culprit, but evidence of that cause has been elusive. Hautmann et al. present data indicating that ocean acidification, possibly caused by high rates of magmatic CO₂ degassing and thermal dissociation of marine gas hydrates, was responsible for the burst of marine extinctions. They show that carbonate sedimentation was interrupted globally, and that organisms that had skeletons of aragonite or high-Mg calcite were preferentially affected. Thus, it seems that high concentrations of atmospheric CO₂ were in fact the proximal cause of the Triassic-Jurassic extinction event, a conclusion that has direct bearing on the marine gas hydrate hypothesis. — JFF


**MOLECULAR BIOLOGY**

**Silencing miRNAs**

In embryonic stem cells, the genes that specify differentiated cells are silenced. The extent of regulation of microRNAs (miRNAs), which also contribute to tissue differentiation, has been unclear because of the difficulty in locating their promoters. Marson et al. have identified the promoters, using a tell-tale trimethylated histone, on the human and mouse genomes in embryonic stem cells and also in precursor neurons and embryonic fibroblasts. In stem cells, some miRNA promoters were occupied by the four transcription factors (Oct4/Sox2/Nanog/Tcf2) that confer embryonic cell pluripotency, and many of the miRNAs were actively transcribed. In contrast, a subset of these miRNA promoters was occupied by Polycomb group proteins, which are known to silence expression, and these Polycomb-bound miRNA genes were specifically induced in the neural precursors and the fibroblast cells. Therefore, like protein-encoding genes, miRNA genes that drive differentiation are repressed in embryonic stem cells. — KK


Glutamate mediates functions such as synaptic plasticity, proliferation, and survival via metabotropic receptors (mGluRs) on neurons and glial cells. Sitcheran et al. demonstrate that glutamate promotes the binding of the p65 and p50 subunits of the transcription factor NF-κB to DNA. Glutamate activation of NF-κB was comparable to that produced by epidermal growth factor (EGF) binding to its receptor EGFR, which is found on astrocytes. Glutamate also induced the phosphorylation and activation of inhibitor of κB kinase α and β (IKKα and IKKβ) and of p65. In canonical NF-κB signaling, IKKβ phosphorylates IκBα, which leads to its degradation and the release of active NF-κB subunits, but glutamate did not increase phosphorylation or degradation of IκBα, although it did dissociate IκBα and p65. Knockdown of EGFR blocked mGluR5-stimulated phosphorylation of p65; conversely, mGluR5 stimulation led to the phosphorylation of tyrosine residues in EGFR and to its association with mGluR5. A Ca²⁺ chelator blocked mGluR5-mediated NF-κB activation, and an inhibitor of EGFR activity reduced mGluR5-stimulated Ca²⁺ signaling. Together, these data suggest that EGFR signaling is critical for the activation of NF-κB by glutamate. — JFF