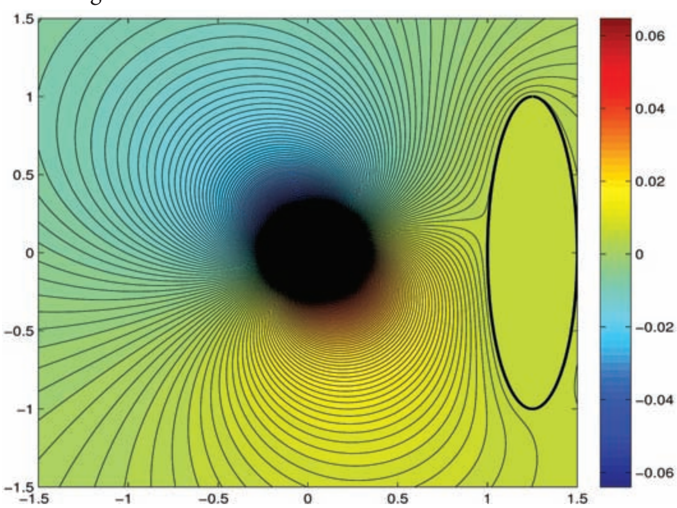
In This Issue

Detecting objects with electro-sensing

Some fish generate a weak electric field for sensing objects in total darkness or highly turbid water. To understand how electrosensing may help detect the presence, location, and shape of objects, Habib Ammari et al. (pp. 11652–11657) mathematically modeled how fish shaped as a twisted ellipse, such as an electric eel, and a straight ellipse, such as a ghost knifefish, might electrically perceive eight objects with different electrical properties. The authors found that the presence of an object could perturb the electric field generated by the fish, and that those perturbations may be perceptible at the surface of the fish's skin. Further, electrical sensitivity at multiple frequencies can enhance sensing of living organisms. Electrically sensitive fish may be able to determine the shape of objects by comparing electrical perturbations corresponding to different geometrical shapes with a learned set of shapes. The results suggest a scheme for electrical sensing of objects by weakly electrical fish, according to the authors. — P.G.



Perturbations in potential of weak electric field of fish (*Right*) caused by object (*Center*).

Global view of protein evolution

Just as the elements in the periodic table can be traced back to the Big Bang, the set of all proteins in terrestrial organisms reflects the history of evolution on Earth. A global view of this so-called protein universe would help reveal how proteins evolve and are related to one another, but empirical evidence exists for relatively few relationships between proteins. Sergey Nepomnyachiy et al. (pp. 11691–11696) applied network theory to a representative set of all known protein domains drawn from the Structural Classification of Proteins (SCOP) database. The authors represented protein space using two network configurations: a domain network in which edges connect domains with segments that share similar sequence and structural motifs, and a motif network in which edges connect recurring motifs that lie within the same domains. The authors demonstrate how networks suggest evolutionary paths between domains and provide clues about the mechanisms of protein evolution. The findings offer an approach to representing protein space that could aid protein design, according to the authors. — T.J.

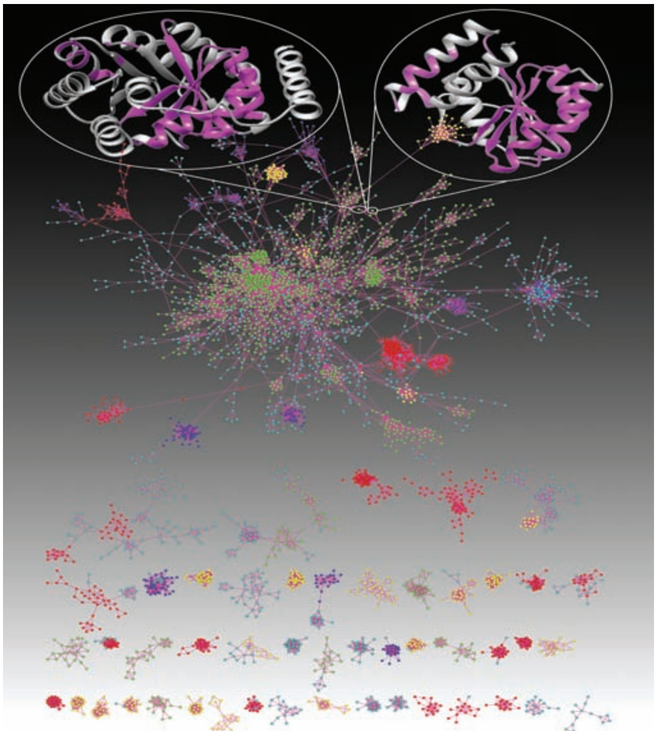


Image courtesy of Varda Wexler (Tel Aviv University, Tel Aviv).

Network view of protein space reveals discrete and continuous regions.

Impacts of *Deepwater Horizon* spill on coral communities

The full impact of the 2010 *Deepwater Horizon* (DWH) oil spill on the Gulf of Mexico remains unknown. Several months after the spill, researchers discovered a coral community significantly affected by the spill at a depth of more than 1,300 m. Charles Fisher et al. (pp. 11744–11749) documented five additional previously unknown coral communities off the coast of Louisiana, up to 22 km from the site of the spill, at depths up to 1,950 m. Although the petroleum residues previously discovered on affected coral communities have since dispersed, the authors found characteristic patchy patterns of hydrozoans on dead coral skeletons in two of the coral communities, suggesting spill impact. The authors report that in the coral community nearest to the spill site, more than 90% of the coral showed signs of recent petroleum impact. Further, the authors found coral entangled in deep-sea fishing lines in two of the coral communities. Most known deep-water coral communities in the Gulf do not display signs of acute impact from the DWH spill, the authors report. The results, however, expand the known impact area of the spill and uncover multiple aspects of anthropogenic impact on coral communities in the Gulf of Mexico, according to the authors. — P.G.

Epigenetics and emotionality

Epigenetic modifications to chromatin, in which histones are modified after translation, can affect neural responses and behavior following stress or substance abuse. To identify whether certain emotional phenotypes may arise from epigenetic modifications, Sraboni Chaudhury et al. (pp. 11834–11839) examined the levels of a trimethylated histone protein, H3K9me3, in rats bred to exhibit different patterns of emotional reactivity. Genetically bred high-responder rats display drug-seeking behavior and responsiveness to novelty, whereas low-responder rats are prone to anxiety and depression-like symptoms. Levels of H3K9me3 differed significantly between the two rat groups in the hippocampus, amygdala, and nucleus accumbens brain regions. Further, the authors identified the growth factor 2 (FGF2) promoter as a key site of interaction with H3K9me3, as levels of association between FGF2 and H3K9me3 differed reciprocally between the rat groups. Because FGF2 has been previously associated with modulation of anxiety-like symptoms, the authors injected FGF2 into newborn low-responder rats, and observed that interactions with H3K9me3 led to behavior more typical of high-responder rats than low-responder rats. Also, by knocking out the FGF2 gene in high-responder rats, the authors elicited behavior more typical of low-responder rats than high-responder rats. The results suggest that *FGF2* modifies epigenetic mechanisms associated with emotional responsiveness, according to the authors. — P.G.

p53 isoform reprograms cells toward metastatic-like state

The p53 tumor suppressor is among the best-studied proteins in molecular biology. Though much is known about the protein's activity and regulation, the factors influencing its diverse physiological effects remain unclear. Serif Senturk et al. (pp. E3287–E3296) uncovered a hitherto uncharacterized p53 isoform that is naturally produced via alternative splicing, a regulatory process that allows a single gene to code for multiple different proteins. The evolutionarily conserved isoform—p53Ψ—is formed when the *TP53* mRNA is spliced at an alternative site on the 3' strand of intron 6, the authors report. In contrast to other forms of p53, p53Ψ lacks the ability to bind specific DNA sequences and cannot activate some of the best-known p53 target genes. The authors note that p53Ψ is expressed in response to tissue injury and in highly metastatic tumors, and that it reprograms cells to exhibit features associated with prometastatic phenotypes. Similar to other known p53 gain-of-function mutants, p53Ψ dampens the expression of E-cadherin, a protein involved in cellular adhesion, activates markers of the epithelial–mesenchymal transition, and enhances the motility and invasive capacity of tumor cells. According to the authors, the finding that p53Ψ is expressed in tumors as well as during tissue injury could shed light on the regulatory pathways that govern tumor metastasis. — A.G.

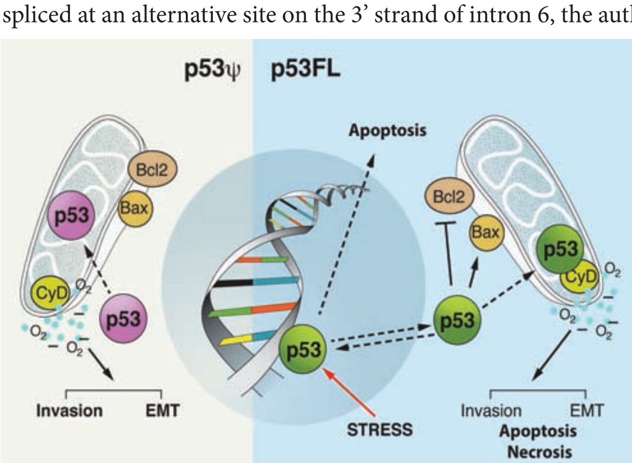


Image courtesy of Raffaella Sordella and Julia Kuhl (Cold Spring Harbor Laboratory, Cold Spring Harbor, NY).

Proposed mechanism of p53Ψ-induced epithelial-mesenchymal transition (EMT).

Role for astrocytes in object recognition

Patterned oscillations in gamma waves produced by neural activity in the brain underlie normal cognitive and motor functions, including memory storage and retrieval, but the mechanisms that produce these oscillations are unclear. Hosuk Sean Lee et al. (pp. E3343–E3352) investigated whether astrocytes, the most common type of nonneuronal cell in the brain, may play a role in creating or maintaining normal gamma oscillations. The authors induced gamma oscillations in mouse hippocampal slices in vitro and observed increases in astrocytic calcium concentrations large enough to induce astrocytes to release vesicles. To test whether calcium-induced vesicle release by astrocytes influenced gamma oscillations, the authors engineered a mouse strain in which vesicle release could be temporarily blocked. Blocking vesicle release did not interrupt neuronal activity in the engineered mice, but gamma oscillations in vivo were reduced. During memory tests, the engineered mice failed to recognize objects to which they had been introduced recently, but performed normally in other tests of cognitive learning. Applying glutamate receptor agonists to hippocampal slices in vitro restored normal gamma wave oscillations, and reversing blockage of vesicle release by astrocytes in the engineered mice restored object recognition. According to the authors, the results suggest that astrocytes help maintain gamma oscillations necessary for novel object recognition. — J.P.J.

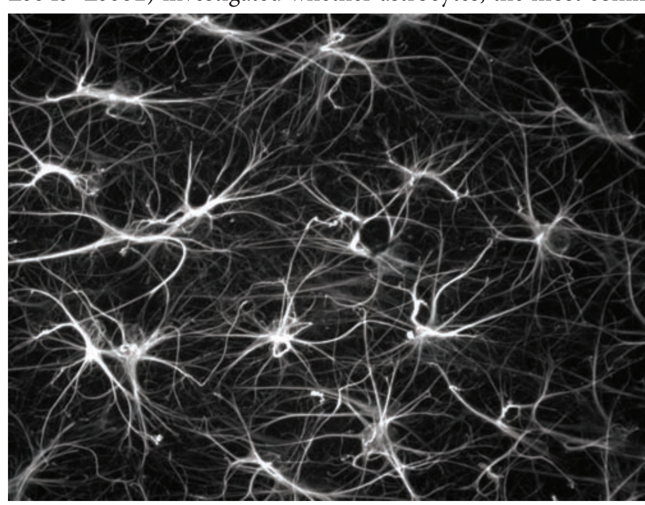


Image courtesy of Wikimedia Commons/Yann Bernardinelli.

Hippocampal astrocytes of a mouse.