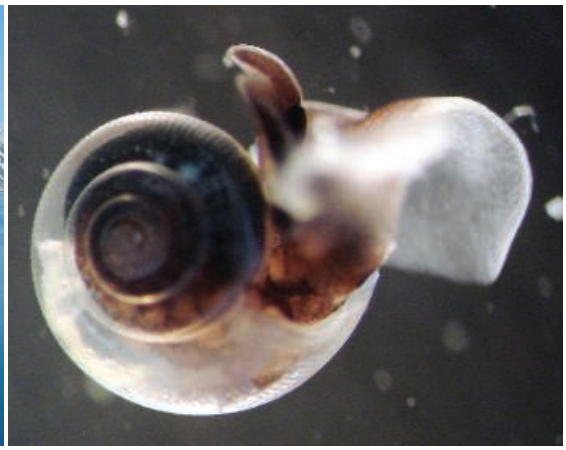


OCEAN SCIENCE

Dissolute Behavior Up North

Some species of sea butterfly have shells composed of aragonite, a metastable form of calcium carbonate. These pelagic mollusks are considered sentinels for environmental change; even though they can survive for a couple of days in water depleted of calcium carbonate, their shells already begin to show dissolution marks.

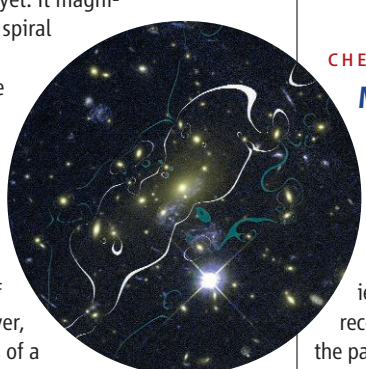
Comeau *et al.* have collected pteropods (*Limacina helicina*) from Kongsfjorden, Svalbard, to study their response to the acidification of polar waters that has been predicted will occur as atmospheric carbon dioxide increases, carbonate declines, and ice melts. They measured shell calcium flux by calcein staining and ^{45}Ca uptake, which revealed a 28% decrease in calcification as the pH dropped by 0.3 and aragonite saturation fell to 1.00, which is forecast to happen by the year 2100. Below this threshold, aragonite concentrations in seawater are too low to prevent the dissolution of shelled creatures—conditions that spell doom for more than just the sea butterflies. — CA

Biogeosciences **6**, 1877 (2009).

ASTRONOMY

Galactic Blowup

The deflection of light in the gravitational field of massive objects causes clusters of galaxies to act as cosmic lenses, magnifying and distorting the light of the galaxies that lie behind them. By analyzing Hubble Space Telescope archival images of the cluster MACS J1149.5+2223, Zitrin and Broadhurst have identified the most powerful gravitational lens yet: It magnifies a background spiral galaxy 200 times (summed over five multiple images). Distant galaxies normally appear as thin distorted arcs around the centers of clusters. In the case of this cluster, however, the lensed images of a background spiral galaxy are large and appear relatively undistorted, implying a nearly uniform mass distribution in the center of the cluster. The authors constructed a model of the mass distribution of the cluster to reproduce the lensed images they could readily identify, and they were then able to use it to predict the location of other images, ultimately identifying a total of 10 sets of multiple images of background galaxies. The refined model that reproduces all of these images is at odds with predictions made by simulations of the evolution of galaxies and associated large-scale distribution, thereby challenging our current theoretical models for the formation of structure in the universe. — MJC



Astrophys. J. **703**, L132 (2009).

CHEMISTRY

Microwave-Safe Dishes

Numerous conveniences available in the chemistry laboratory (magnetic stirrers, for instance) have been slow to make their way into the kitchen. Chefs can still brag, though, that the ultimate kitchen convenience—the microwave oven—has only recently been widely exploited in the lab. Over the past decade, chemists have begun to explore more systematically the utility of intense microwave sources for accelerating organic reactions. The question remains, however, whether microwave technology is simply a means of achieving very rapid heating, or whether specific reaction pathways might be selectively enhanced through molecular absorption in this wavelength region. In part to address this question, Obermayer *et al.* fabricated a silicon carbide (SiC) reaction vessel, which absorbs microwaves far more efficiently than conventional Pyrex labware and thus transmits their energy to chemical reagents in conventional thermal fashion. On performing a diverse set of 18 organic reactions under microwave irradiation in both Pyrex and SiC, the authors observed no evidence of nonthermal chemistry. — JSY

Angew. Chem. Int. Ed. **48**, 10.1002/anie.200904185 (2009).

DEVELOPMENT

Pregnancy Can Be Stressful

When cells and tissues experience environmental stress, the endoplasmic reticulum (ER)—a membrane-bounded intracellular compartment—accumulates incorrectly folded proteins. The inositol requiring enzyme–1 (IRE1) mediates an unfolding protein response (UPR) that relieves ER stress by activating the expression of genes that participate in protein quality control.

Prior work has documented embryonic lethality in mice after inactivation of IRE1. Using in vivo imaging and knockout mice, Iwawaki *et al.* show

CREDITS (TOP TO BOTTOM): STEEVE COMEAU, CNRS-UPMC; ZITRIN *ET AL.*, *ASTROPHYS. J.* **703**, L132 (2009)

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that IRE1 functions in the placenta after ER stress induction. In mice lacking IRE1, vascular endothelial growth factor–A was reduced and angiogenic defects were seen in the labyrinth layer of the placenta, consistent with diminished transport of oxygen and other nutrients. Therefore, IRE1 functions, at least in part, in extraembryonic tissues during early development. — BAP

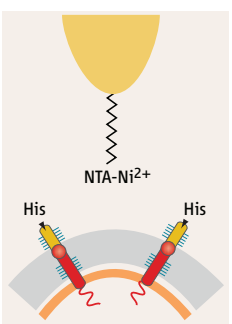
Proc. Natl. Acad. Sci. U.S.A. **106**, 10.1073/pnas.0903775106 (2009).

BIOPHYSICS

Embedded Sensors

Drugs used in the treatment of fungal infections are often directed against the protective fungal cell wall (gray). Hence, a better understanding of how cell wall integrity is maintained under dynamic and stressful conditions has pharmaceutical implications. Proteins anchored in the underlying plasma membrane (orange) are thought to detect surface stress and to mediate adaptive responses, but the biophysics of stress sensing is unclear.

Dupres *et al.* have used atomic force microscopy (AFM) to characterize the response of the yeast plasma membrane protein Wsc1 to mechanical stress. Although the outer end of wild-type Wsc1 (red) is buried within the cell wall, adding a short extension (yellow) containing a histidine tag rendered the fusion protein accessible to a Ni^{2+}-derivatized AFM tip. Scanning the surfaces of live yeast cells and focusing on individual Wsc1 molecules revealed that they exhibited Hookean behavior with a spring constant of roughly 5 pN nm^{-1}. That is, lengthening of Wsc1 was linearly proportional to the force applied. This force-extension behavior required glycosylation (blue), which is expected to favor an extended and relatively stiff protein conformation and may be a key factor in the function of this nanospring. — LC



CREDIT: DUPRES *ET AL.*, *NAT. CHEM. BIOL.* **5**, 10.1038/NCHEMBIO.220 (2009)

Nat. Chem. Biol. **5**, 10.1038/nchembio.220 (2009).

EDUCATION

Enough Room for All

Debate about immigration and how it might strengthen or weaken a society often touches on education. Some opponents of immigration voice concerns that an influx of noncitizen foreigners may swamp school systems and labor markets with relatively uneducated newcomers, to the detriment of natives. Research has supported some fears of this sort, demonstrating, for example, that the enrollment of immigrants in some college programs may "crowd out" natives. But while such research has examined whether natives ultimately go to college and how well they fare once there, work by Neymotin examines important precursors: Do immigrants affect natives at key pre-college stages, as reflected by college entrance exam scores—obtained in the U.S. on the scholastic aptitude test (SAT)—and college application patterns? The 1990s brought one of the largest waves of immigration, with California and Texas representing two major gateways. The author analyzed questionnaires and SAT scores for every SAT-taking public school student in those two states during the years 1994 through 2001. These individual-level data were matched to information about the school, school district, and surrounding community gathered by the Department of Education and Census Bureau. Controlling for a wide range of variables and potential biases, the author concludes that immigration did not harm natives' test performance, nor diminish the probability of their applying to a top college or university. — BW

Econ. Educ. Rev. **28**, 538 (2009).

MATERIALS SCIENCE

A Penetrating Simulation

Simulating the diffusion of small molecules in a polymer melt is a difficult task on account of the multitude of length and time scales that must be accommodated, ranging from the fast motions of individual chain segments and pendant groups to the much slower fluctuations of the polymer backbones. Fritz *et al.* show that a hierarchical model can be used to calculate the diffusion coefficients and excess chemical potentials (solubilities) for ethylbenzene diffusion in atactic polystyrene melts. Diffusion coefficients were first obtained using molecular dynamics simulations of coarse-grained (CG) models, wherein each CG bead represented 5 to 10 atoms and the interactions between beads were guided by potentials derived from all-atom simulations, thus reducing the computational time by several orders of magnitude. By comparing the CG results with those from high-temperature, all-atom simulations, in which equilibration occurs quickly, the authors could extrapolate time scales to lower temperatures using a Volger-Fulcher relationship. The excess chemical potential was determined by thermodynamic integration of the work needed to perturb the system from state A to state B, thereby coupling the solute-polymer interactions. The authors believe that their methods can be applied for fast, quantitative calculations in the limiting case where penetrating molecules are similar in size to the polymer repeat unit. — MSL

Soft Matter **5**, 10.1039/b911713j (2009).