ENDOCRINOLOGY

It's in Her Eyes

Crustaceans go through pubertal molt to provide the animal with features that are distinct to adults. The androgenic gland hormone (AGH) is important for male differentiation and secondary male characteristics. Females lack AGH, so are considered the default sex for development. Previous work has shown that when the eyestalk is ablated in the females of some crab species, mating and maternal care structures show defects; however, the animals are able to molt and develop into giant immature crabs. In studying the blue crab, *Callinectes sapidus,* Zmora *et al*. now show that the endocrine system and localized activity of a hormone termed crustacean female sex hormone (CFSH) from the eyestalk ganglia are involved in adult-specific development through the control of the pubertal-terminal molt. When CFSH is eliminated, the brooding features, which are important for mating and brooding large clutches, are abnormal. This work shows that the endrocrine system functions via a female-specific hormone for the development of adult morphological structures associated with female reproduction, i.e., for mating and brooding. — BAP

Endocrinology 10.1210/en.2013-1603 (2013).

CLIMATE SCIENCE

A Question of Balance

Arctic permafrost is thought to contain twice as much carbon as the atmosphere. As climate warming causes increasing amounts of that permafrost to melt, release of carbon as methane or carbon dioxide (CO_2) may cause additional, rapid warming. However, it is likely that at least some of the carbon made available by permafrost melting will be used by the vegetation that is appearing in warming regions, but how large a sink that may be is unknown. Lupascu *et al.* report that in High Arctic tundra—an important subset of permafrost terrain, which is experiencing a complex combination of rising temperatures, increasing precipitation, and permafrost degradation—warming alone increases the summertime CO_2 sink strength by up to 55%, but warming combined with wetting increased the CO_2 sink strength by an order of magnitude. Thus, the High Arctic has the potential to remain a strong carbon sink even if the rest of the Arctic permafrost region becomes a net carbon source due to future global warming. — HJS

Nat. Clim. Change 10.1038/NCLIMATE2058 (2013).

CREDITS (TOP TO BOTTOM): MOLEFRANZ/ISTOCKPHOTO; INSAPPHOWETRUST/FLICKR

MOLECULAR BIOLOGY

Polymerase Proofreader

For organisms to grow, and their cells divide, the genomes they contain must be replicated quickly and accurately. In eukaryotes, three DNA polymerases handle genome duplication: Pol α, which makes short RNA-DNA primers; Pol δ, which discontinuously replicates the lagging DNA strand and Pol ε, which replicates the leading strand, in a largely continuous and highly processive manner, unlike the other polymerases. Hogg *et al.* determine the 2.2 Å resolution crystal structure of the catalytic core of yeast Pol ε caught in the act of polymerization—bound to DNA and with an incoming dATP base. As well as the typical fingers, palm, thumb, exonuclease, and N-terminal domains, yeast Pol ε has a novel "P" domain that extends from the palm and encircles the DNA, embracing it as it leaves the active site. The P domain facilitates the high intrinsic processivity of Pol ε, independently of the processivity clamp protein, PCNA. It also extends the interactions between Pol ε and DNA by up to 10 nucleotides. Hogg *et al.* speculate that this much extended interface may contribute to Pol ε's high replication fidelity by allowing Pol ε to proofread the newly synthesized DNA for errors up to 45 Å from the active site. — GR

Nat. Struct. Mol. Biol. 10.1038/nsmb.2712 (2013).

SIGNALING

Good Gut Bugs

The trillions of bacteria in the human gut are important for normal digestion and can contribute to disease when their beneficial actions are lost. They also communicate with and modulate the behavior of the intestinal cells that they contact. Jones *et al.* examined the signaling mechanisms by which Lactobacilli, bacteria that we consume in cheese and yogurt, stimulate normal proliferation of intestinal cells in fruit flies and mice. These beneficial bacteria caused activation of NADPH oxidase, an enzyme that produces reactive oxygen species (ROS). Oddly enough, production of large amounts of ROS by phagocytes or in the intestine is a defense mechanism for killing bacteria. The smaller amounts produced in response to the Lactobacilli, however, had the beneficial effect of promoting cell proliferation needed for a healthy intestine in the flies and mice tested. Patel *et al.* point out in a commentary that the difference between the reaction to pathogenic and friendly bacteria may thus be primarily in the amount, rather than the type, of signal produced. — LBR

EMBO J. **32** 10.1038/emboj.2013.224; 10.1038/emboj.2013.244 (2013).

Downloaded from www.sciencemag.org on January 3, 2014

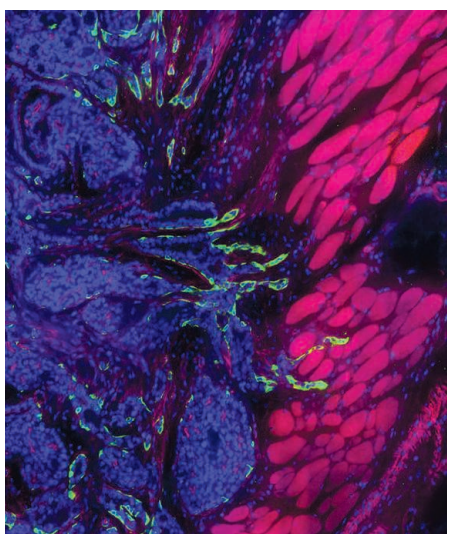
Continued from page 7

CANCER

Leading the Invasion

Metastasis of solid tumors requires that normally immotile epithelial cancer cells acquire the ability to invade surrounding tissue. Current models depict invasion as a multicellular event dependent on the collective action of stromal cells and specialized, but poorly defined, subpopulations of cancer epithelial cells. Identifying the distinguishing molecular features of the most invasive cells could potentially provide new targets for therapeutic intervention.

Studying breast cancer invasion in vitro, in mouse models, and in human tumor samples, Cheung *et al.* found that the cancer cells "leading" the invasion expressed genes characteristic



of basal epithelium, including *cytokeratin-14* (*K14*) and *p63*. The leader phenotype appeared to be a differentiation state rather than a fixed lineage, as *K14*-negative luminal cells (a mammary epithelial cell type that gives rise to most breast cancers) were found to undergo conversion to invasive behavior in vitro, concomitant with the acquisition of *K14* expression. Notably, shRNA-mediated inhibition of *K14* or *p63* expression blocked the invasive capacity of breast tumors in vitro, suggesting that therapies aimed at disrupting the basal epithelial program might impede metastasis. — PAK

Cell **155**, 1639 (2013).

CHEMISTRY

Mirror, Mirror on the Wall

What's the strongest acid of them all? In the case of Brønsted acidity, associated with the tendency to lose a proton, it depends on the surrounding medium. The pK_a scale was originally grounded in reactivity toward water, but many common solvents are inherently less basic, which allows discrimination of acids that would otherwise all dissociate fully under aqueous conditions. Halogenated carboranes have emerged as the weakest class of conjugate bases in this context; unlike antimony pentafluoride-derived superacid conjugates, they lack a highly Lewis acidic component. Nava *et al.* report the synthesis and isolation of an acid with the fluorinated carborane $CHB_{11}F_{11}$ as its conjugate, following up on a report several years ago of its preparation and the vibrational spectrum of an ethyl-substituted analog. Because this compound is sufficiently acidic to cleave alkyl C-H bonds by protonolysis, it was crucial to exclude organic impurities (as well as water) during the steps prior to its ultimate purification by sublimation. Suspension of the solid in hexane was observed to liberate hydrogen at room temperature in 50% yield within 2 hours, a substantial rise in reactivity relative to the previous Brønsted champion, which bore a chlorinated carborane conjugate; butane reacted similarly. — JSY

Angew. Chem. Int. Ed. 10.1002/anie.201308586 (2013).

EDUCATION

Fostering Self-Worth

First-generation college students, where neither parent received a 4-year college degree, tend to perform more poorly and have higher dropout rates than continuing-generation students, who have at least one parent with a 4-year degree. Harackiewicz *et al.* hypothesized that offering first-generation students the chance to remind themselves of their personal values—for example, creativity, career aspirations, or the desire to be independent—may help them to foster their self-worth and thus lead to an improvement in performance and to lower dropout rates. The authors used the values affirmation (VA) intervention, which involves students writing about their most important values, on 798 U.S. students (154 first-generation) in an introductory biology course. Before taking biology tests, students in the VA group were instructed to circle the values most important to them among 12 given values, whereas students in the control group were asked to circle the values least important to them. The VA intervention narrowed the achievement gap between first- and continuing-generation students by 50% and increased retention of first-generation students by 20%. Thus, interventions that change the mindset of students are powerful and can complement interventions that focus on changing the learning environment. — FB

J. Educ. Psychol. 10.1037/a0034679 (2013).

CREDIT: K. J. CHEUNG *ET AL.*, *CELL* **155**, 1639 (12 DECEMBER 2013) © 2013 ELSEVIER INC.