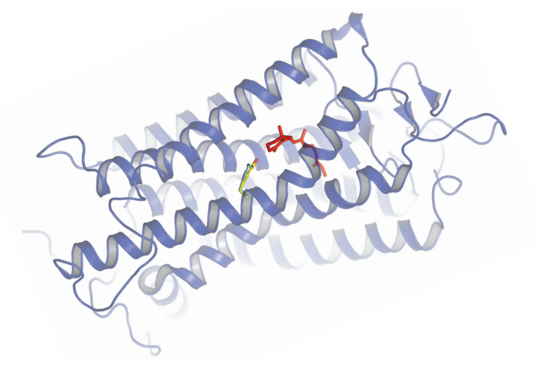
In this issue . . .

Rice maturity time and yield

Ef-cd near-isogenic lines hybrid E-Y-Liangyou527 (Y58S/E-Shuhui527, *Right 4 lines*) matured earlier than the corresponding hybrid Y-Liangyou527 (Y58S/Shuhui527, *Left 4 lines*) in Chengdu, China.

Boosting rice yields per unit area could help mitigate future food shortages faced by Earth's rapidly expanding population. Although rice breeders have developed cultivars that mature rapidly enough to produce more than one crop per year, shortening the growing season results in a correspondingly low yield. Jun Fang, Fantao Zhang, et al. (pp. 18717–18722) suggest that naturally occurring variants in the *Early flowering-completely dominant* (*Ef-cd*) gene can be exploited to produce cultivars that mature more rapidly without incurring a yield penalty. The authors demonstrate that *Ef-cd* lies in a quantitative trait locus associated with maturity duration and that its expression positively correlates with proteins related to flowering time. Field tests revealed that near-isogenic cultivars with the early-maturing *Ef-cd* allele mature 7–20 days faster and produce yields that do not differ significantly from wild-type hybrids. Furthermore, RNA sequencing and differentially expressed gene analyses reveal that *Ef-cd* upregulation increases nitrogen use efficiency and photosynthesis rates in rice plants. The findings suggest that *Ef-cd* can be modified to produce rice cultivars that strike a balance between maturity time and yield, according to the authors. — T.J.

Adaptation to light and convergent evolution in fishes

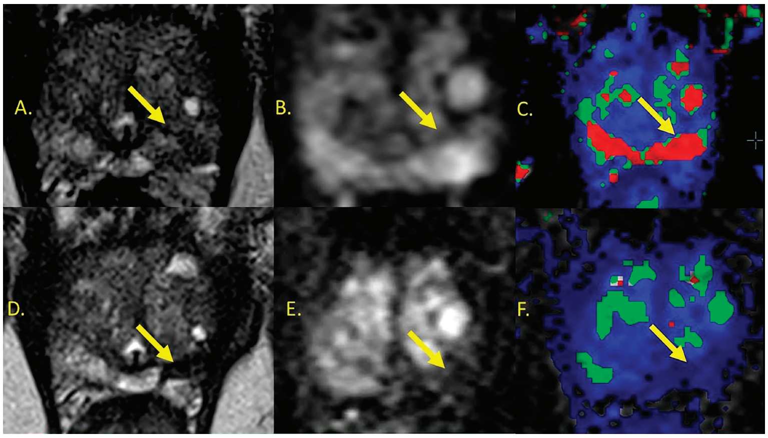


Herring rhodopsin (blue) showing chromophore retinal (red), location of residue 261, and difference between phenylalanine (turquoise) and tyrosine (yellow/red).

When species colonize new environments, they evolve traits that contribute to biodiversity on Earth. However, the factors and interactions that drive genetic adaptation and maintain biodiversity are not well understood. Jason Hill et al. (pp. 18473–18478) examined differences between Atlantic and Baltic herring—fish populations that began to diverge around 10,000 years ago when Atlantic herring colonized the brackish Baltic Sea—and identified a missense mutation in the visual pigment rhodopsin (Phe261Tyr) that represents an adaptation to the Baltic Sea light environment. Compared with the blue waters of the Atlantic Ocean, the water of the Baltic Sea contains dissolved organic matter, which causes a red shift in the underwater visual environment. The authors found that the rhodopsin adaptation, a transition from the amino acid phenylalanine to tyrosine at a single site, allows a visual receptor in the fish to better absorb red light. Further, the authors found that the mutation occurred more than 20 times across a range of fish species that adapted to similarly red-shifted light environments in freshwater or brackish environments. The findings offer distinct examples of a specific adaptation evolving via the same mutation and, thus, a remarkable illustration of convergent evolution, according to the authors. — T.J.

Nanoshells help treat prostate tumors

Prostate cancer is a leading cause of cancer death among men in the United States. Currently available whole-gland treatment strategies carry undesirable side effects. In a small clinical trial exploring a targeted approach, Ardeshir Rastinehad et al. (pp. 18590–18596) demonstrate the safety and feasibility of gold-silica nanoshells designed to convert near-infrared light into heat for photothermal ablation of prostate tumors. Fifteen patients diagnosed with low-risk or intermediate-risk localized prostate cancer received an intravenous infusion of the nanoshells, which accumulate preferentially within tumors in part due to their abnormal vasculature. One day after treatment, guided by magnetic resonance–ultrasound (MR/US) fusion imaging, a laser catheter housing an optical fiber was used to deliver near-infrared light through thin tubes inserted into the prostate, heating the nanoshells. None of the patients reported serious side effects during the procedure or at the 90-day follow-up. At 12 months, MR/US fusion biopsies revealed that 14 out of 16 treated lesions showed no evidence of tumor in the ablation zone. However, a large-scale study is needed to assess the efficacy of this approach. According to the authors, photothermal ablation of prostate tumors using gold-silica nanoshells could represent a targeted therapeutic strategy that reduces the risk of serious side effects. — J.W.



Nanoshell-mediated photothermal ablation successfully treated tumor. *A–C*: pretreatment, *D–F*: posttreatment.

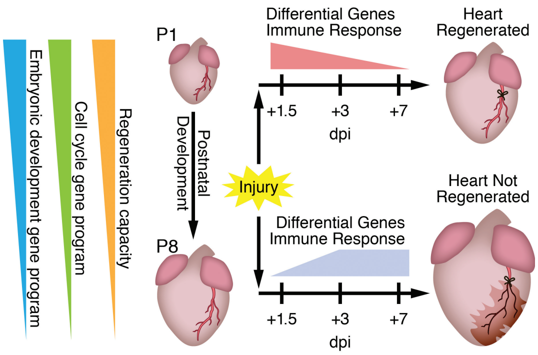
Optimism and exceptional longevity

Studies regarding exceptional longevity, defined as living to age 85 or older, have largely focused on biomedical rather than psychological factors. To examine the effects of optimism on exceptional longevity, Lewina Lee et al. (pp. 18357–18362) analyzed data from 69,744 women from the Nurses' Health Study and 1,429 men from the Veterans Affairs Normative Aging Study. The women's age range was 58–86 years when they completed an optimism assessment in 2004, and their mortality status was tracked through 2014; the men's age range was 41–90 years when they completed an optimism assessment in 1986, and their mortality status was tracked through 2016. The authors found that higher optimism was associated with increased odds of exceptional longevity, even after taking into account other relevant factors, such as demographics, health conditions, and health behaviors. On average, more optimistic individuals demonstrated 11–15% longer life span than less optimistic individuals. The findings suggest that optimism may be an important factor for healthy aging, according to the authors. — M.S.

Optimism may lead to a longer life. Image courtesy of Pixabay/silviarita.

Transcriptional landscape of neonatal heart regeneration

Adult mammalian heart cells cannot regenerate following injuries such as heart attacks. In contrast, neonatal mouse hearts can regenerate following injury, but only during the first week after birth, and the basis of this ability is poorly understood. Zhaoning Wang, Miao Cui, et al. (pp. 18455–18465) examined gene expression and chromatin landscapes, as well as response to myocardial infarction (MI), in regenerative and nonregenerative mouse hearts. MI triggered distinct responses in expression of genes related to immunity in 1-day-old and 8-day-old mouse hearts, as measured by transcription and chromatin activation and deactivation. One of the genes preferentially expressed in 1-day-old mouse hearts encoded a macrophage-secreted factor, CCL24, which promoted proliferation of neonatal rat heart cells in vitro. The authors further identified a set of genes that were expressed in the heart during embryonic development and early neonatal stages, when hearts were capable of regeneration, but were silenced in adults. One of these genes encoded the RNA-binding protein IGF2BP3, and 8-day-old mouse hearts overexpressing this protein exhibited enhanced post-MI regeneration and cardiac function, compared with controls. According to the authors, neonatal hearts may exhibit a unique immune response to injury and retain an active developmental gene program, which together promote heart regeneration. — B.D.



Unique injury response and developmental gene program orchestrate neonatal heart regeneration.

Intelligence and practice in skill development

Existing research supports roles for both intelligence and practice in human skill development, but the relative importance of these factors and their potential interplay are debated. In a longitudinal study of 90 Austrian chess players, ages 10–77, Nemanja Vaci et al. (pp. 18363–18369) examined the simultaneous influence of intelligence and practice on the development of chess skills throughout the lifespan. The authors found that both a player's numerical intelligence, as measured by an established test, and number of tournament games played per year, a measure of practice, were positively associated with skill level. More importantly, the authors found that a model that included an interaction between intelligence and practice could explain more of the variance in skill among players than one in which both factors acted independently. With a given amount of practice, more intelligent players acquired chess skill more quickly, reached a higher peak performance, and arrested decline earlier in older age compared with their less intelligent colleagues. The results highlight the interplay between intelligence and practice in acquiring and retaining complex skills. According to the authors, the findings support a central tenet of intelligence theories—widely assumed but rarely empirically proven—that more able people benefit more from the same amount of learning activity. — B.D.

Intelligence and practice interact to influence chess players' skill level. Image courtesy of Pixabay/jarmoluk.