In This Issue

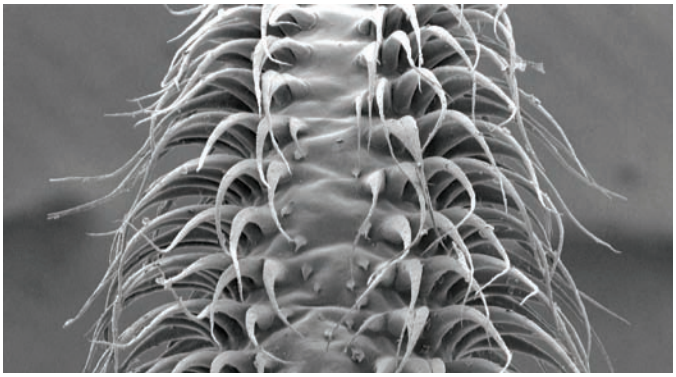
Alligators lend a model for human tooth replacement

Most vertebrates can renew teeth throughout their lives, whereas human teeth are naturally replaced only once despite the lingering presence of a band of epithelial tissue called the dental lamina, crucial to tooth development. To uncover molecular mechanisms of tooth renewal, Ping Wu et al. (pp. 8775–8776) studied repetitive tooth formation in American alligators. Because alligators have well-organized teeth with morphological traits similar to those of mammalian teeth—such as secondary palates and implantation in dental bone sockets—and are capable of lifelong tooth renewal, the authors reasoned that the long-lived reptiles, which can replace each of their 80 teeth up to 50 times, might serve as models for mammalian tooth replacement. Through a combination of histological, molecular, and imaging techniques, the authors found that each alligator tooth is a complex unit of three components in different developmental stages that are structured to facilitate replacement once they are dislodged. The authors report that at an early tooth development stage, the alligator dental lamina forms a bulge at its distal tip that houses putative, quiescent stem cells. Molecular analysis revealed that the initiation of the tooth cycle corresponds with the dynamic expression of an array of signaling molecules implicated in tooth development. According to the authors, the findings might aid efforts to trigger tooth renewal in human adults who have lost teeth or to curb uncontrolled tooth development in people with supernumerary teeth. — P.N.

Alligator teeth are arranged in tooth family units with three members at each position, enabling repetitive replacement.

How bats use erectile hair-like structures to collect nectar

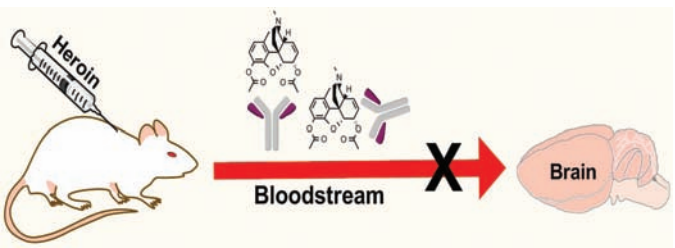
Nectar-feeding bats have protrusible tongues with elongated, hair-like papillae at the tip, and these papillae have long been considered passive structures. Cally Harper et al. (pp. 8852–8857) used high-speed video to visualize the movements of the tongue and papillae of the nectar-feeding bat, *Glossophaga soricina*, and found that blood flow within the tongue tip increased during nectar-feeding and papillary veins became engorged with blood, causing the rows of papillae to become erect. The papilla erection was found to persist throughout tongue retraction and nectar was found to be trapped between the papillae and carried into the bat's mouth. Postmortem experiments revealed that papilla erection could be produced by saline injection, suggesting a hydraulic mechanism. Tongue elongation and papilla erection likely increase the nectar gathering ability of *G. soricina*, and help the animals take advantage of limited nectar resources to fuel their energy intensive lifestyle, according to the authors. The tongue of *G. soricina* can rapidly increase in length and change its surface configuration, and could thus serve as a valuable model for the development of miniature surgical robots and surgical instruments for procedures such as angioplasty and gastric endoscopy, the authors suggest. — S.R.



Scanning electron micrograph of the tip of a nectar-feeding bat's tongue after saline injection.

Improved heroin vaccine shows promise in rats

Among drugs of abuse, heroin is tied to a high risk of mortality. Although drug treatment can lower the likelihood of relapse among dependent users, access- and compliance-related challenges in medically monitored treatment programs have led researchers to explore vaccines that can bind heroin in the bloodstream and block its effects on the brain. Joel Schlosburg et al. (pp. 9036–9041) previously fashioned an immunologically dynamic vaccine with properties designed to match heroin metabolism and reported that the vaccine triggered high titers of antibodies against heroin and its active metabolites. To test the vaccine's selectivity for and efficacy against heroin, the authors used a rat model of heroin reward, relapse, and compulsive intake, representing first-time and experienced heroin use. Compared with mock-vaccinated rats and rats given a vaccine effective against only one of heroin's metabolites, the authors report that the dynamic vaccine, conjugated to a carrier protein and administered with an alum adjuvant, was more effective at sequestering

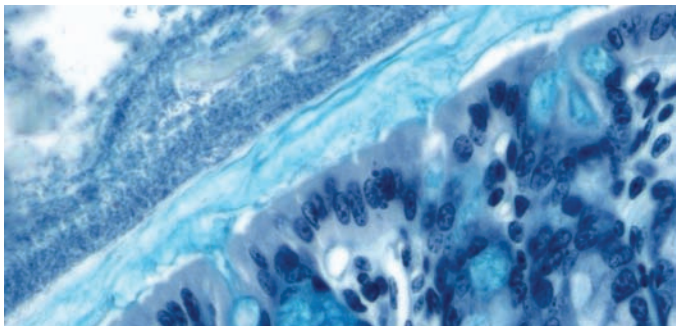


Blocking heroin's action on the brain.

heroin's brain-permeable components in the blood. In addition, the vaccine largely blocked heroin's analgesic and rewarding effects on the brain, heroin-induced drug-seeking behavior, and compulsive heroin self-administration following abstinence in dependent rats. The vaccine might serve as a tool to supplement current drug treatment, according to the authors. — P.N.

How a gut bacterium affects diet-induced obesity

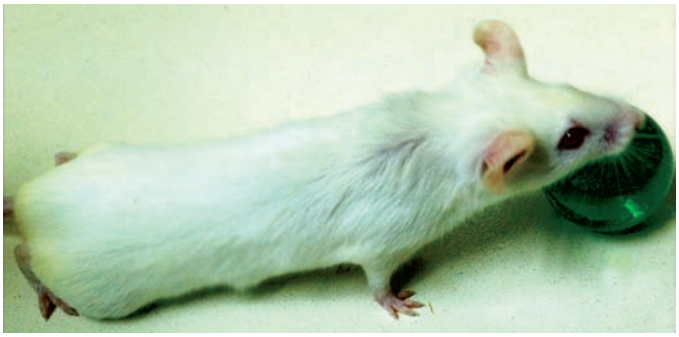
Akkermansia muciniphila is the dominant bacterium residing in the human gut's nutrient-rich mucus layer. The abundance of this mucin-degrading bacterium inversely correlates with body weight and type-1 diabetes in mice and humans, but the bacterium's precise physiological role in obesity and metabolic disorders is unknown. Amandine Everard et al. (pp. 9066–9071) found that the abundance of *A. muciniphila* decreased in obese and type-2 diabetic mice compared with their lean littermates. The authors also observed that administering oligofructose prebiotics to these mice completely restored *A. muciniphila* abundance and was associated with an improved gut barrier and a reversal of obesity-related metabolic disorders such as fat mass gain, adipose tissue inflammation, and insulin resistance. *A. muciniphila* administration increased intestinal levels of endocannabinoids that control glucose and intestinal homeostasis, and counteracted diet-induced decreases in mucosal barrier thickness. The researchers found that these effects required viable *A. muciniphila*, as treatment with heat-killed *A. muciniphila* did not improve the metabolic profile or mucus layer thickness of mice. The results indicate that *A. muciniphila* may play a key role in gut barrier function, metabolic inflammation, and fat storage, according to the authors. — S.R.



A continuous mucus layer is observed over the surface of the colon mucosa.

Common childhood respiratory virus alters nervous system function in rodents

Respiratory syncytial virus (RSV) is a leading cause of respiratory illnesses such as bronchiolitis and pneumonia in infants worldwide. RSV infection is also associated with neurological symptoms such as seizures and ataxia, but the mechanisms linking RSV with nervous system dysfunction remain unclear. Janyra Espinoza et al. (pp. 9112–9117) infected the nasal cavities of mice and rats with RSV and investigated whether the virus could spread to the central nervous system. Within 3 days of infection, the authors detected RSV RNA and proteins in the brain tissue of the animals. Moreover, 30 days postinfection, the animals displayed cognitive impairments while performing various tests of learning and memory. The authors found that these impairments were associated with reduced long-term potentiation, a type of communication between nerve cells that is thought to underlie learning and memory. When the authors vaccinated the animals against RSV prior to infection, they found that the vaccination prevented virus-induced damage to the airways and nervous system. The findings suggest that long-term functional changes in the central nervous system occur following RSV infection, and underscore the need for an effective vaccine against the virus, according to the authors. — N.Z.



Marble burying behavior is impaired in RSV-infected mice.

Targeted interventions stem H5N1 spread in Asia

In Asia live bird trade provides a major transmission pathway for the pathogenic avian influenza virus subtype H5N1. Although vaccinations, culling, and movement restrictions can control avian influenza epidemics in developed countries, these costly strategies are inappropriate in resource-poor settings where most poultry are raised by small-holder owners. To investigate how the structure of live bird markets affects the spread of H5N1 in Asia, Guillaume Fournié et al. (pp. 9177–9182) interviewed live poultry traders in northern Vietnam and constructed a contact network based on the movements of traders between markets. Using social network analysis and individual-based modeling, the authors found that most local markets are connected to one another, suggesting that live bird markets can help transmit diseases like H5N1 across large geographical scales both within the network and potentially across network boundaries to uninfected regions. However, the authors report that targeted interventions, such as daily disinfection of the market environment, traders' vehicles, and equipment in a small number of key hubs, can disrupt the network and prevent the spread of the disease. The findings might help guide public health policy in resource-poor settings where live bird markets are well developed, according to the authors. — T.J.

Live bird market in Vietnam.