

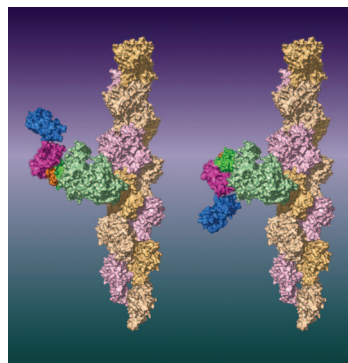
In This Issue

- 772 Myosin VI insert responsible for reverse motion
 778
 876 Competition, not cooperation, drives biofilm production
 979 Intestinal microbiota can alter energy balance
 1039 Critical neural pathway connecting nose to brain
 1087 North China's earliest crops

BIOPHYSICS

Myosin VI insert responsible for reverse motion

Myosin motor proteins “walk” along actin filaments, generating biological motion such as skeletal muscle contraction. Most myosins move toward the rapidly growing, or plus, end of the filaments.



Model of myosin VI power stroke.

However, myosin VI, despite its extensive sequence and structural homology with plus end myosins, walks in the opposite direction. In two separate studies, Hyokeun Park *et al.* and Zev Bryant *et al.* found that a class-specific stretch of amino acids located between the myosin VI converter region and its lever arm is critical for this reverse motion toward the minus end of actin. Without this insert or with a truncated version, myosin VI walked to-

ward the plus end of the actin filaments; it changed course when the insert was reattached. An unusual rotation of the converter domain underlies the myosin VI power stroke, contributing to its large and variable step size. This unconventional movement may help myosin VI play diverse roles in cells, including endocytosis, cell migration, and the maintenance of stereociliar membrane tension in the inner ear. — F.A.

“The power stroke of myosin VI and the basis of reverse directionality” by Zev Bryant, David Altman, and James A. Spudis (see pages 772–777)

and

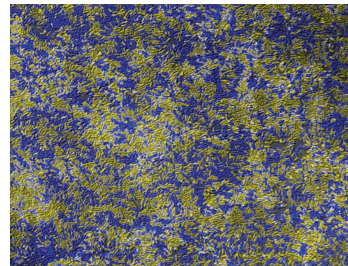
“The unique insert at the end of the myosin VI motor is the sole determinant of directionality” by Hyokeun Park, Anna Li, Li-Qiong Chen, Anne Houdusse, Paul R. Selvin, and H. Lee Sweeney (see pages 778–783)

EVOLUTION

Competition, not cooperation, drives biofilm production

A central aspect of microbial life, biofilms consist of a communal “slime” of enzymes and polymers secreted by microbial cells. Biofilm communities often consist of multiple strains and species. Little is known about how these disparate groups cooperate and avoid “cheater” strains that benefit from the biofilm without expending energy to produce and secrete components.

Joao Xavier and Kevin Foster carried out simulations, using individuals from different microbial strains, that considered carbon fluxes, involved from the uptake of a substrate (glucose), between growth and secretion. The authors observed that evolutionary forces favored polymer secretion. Within bacterial lineages, rapid secretion allowed cells to push future generations into more favorable, nutrient-accessible positions within the biofilm. At the same time, the expansion of these productive cells suffocated less-active polymer producers. Xavier and Foster likened this strategy to vertical growth in plants, with the cells of a tree trunk dividing to allow descendents to rise up to the best growth conditions while blocking out sunlight from competitors. Multilineage biofilm communities do not need to develop a global cooperation system, the authors say, because the selfish drive of each strain ensures that all members will contribute to the production of the entire biofilm. — N.Z.



Pseudomonas aeruginosa biofilm.

“Cooperation and conflict in microbial biofilms” by Joao B. Xavier and Kevin R. Foster (see pages 876–881)

Intestinal microbiota can alter energy balance

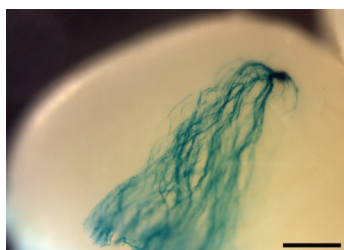
The intestinal tract is host to a vast microbial community that can be viewed as an integral part of human metabolism. Intestinal microbiota thus should be factored in formulating energy balance equations. Fredrik Bäckhed *et al.* highlight two complementary pathways by which gut microbes can affect the development of obesity. The authors find that germ-free mice, engineered to lack an intestinal biota, were protected from obesity when fed a Western-style diet. The leanness of the mice was associated with increased liver and skeletal-muscle levels of phosphorylated AMP-activated kinase (AMPK), a molecular “fuel gauge” that monitors cellular energy metabolism. This obesity protection in germ-free mice was abolished if the animals lacked fasting-induced adipose factor (Fiaf), a lipoprotein lipase inhibitor that is normally suppressed by gut microbes. Although Fiaf-knockout mice had high levels of AMPK, they had reduced expression of other genes involved in fatty acid metabolism. Bäckhed *et al.* suggest that targeting components of the microbiota and/or microbe-regulated gene products such as AMPK and Fiaf may provide strategies for preventing diet-induced obesity. — N.Z.

“Mechanisms underlying the resistance to diet-induced obesity in germ-free mice” by Fredrik Bäckhed, Jill K. Manchester, Clay F. Semenkovich, and Jeffrey I. Gordon (see pages 979–984)

NEUROSCIENCE

Critical neural pathway connecting nose to brain

The neurons dedicated to the sense of smell have >1,000 different odorant receptors to detect the $\geq 3,000$ volatile chemicals responsible for different scents. In mammals, these olfactory sensory neurons of the nose send out axons to the olfactory bulb in the brain, where they coalesce into glomeruli and make synapses. Each glomerulus is populated by axons expressing the same odorant receptor, but how these axons sort themselves into odorant receptor-specific structures has remained unclear. To determine the factors that govern glomeruli formation, Alexander Chesler *et al.* expressed various proteins in



Olfactory axonal sorting.

embryonic mouse olfactory epithelium using a retrovirus to carry the genes. The authors found that, although functional odorant receptors induced axon coalescence as expected, activation of a specific G protein (*G α s*) signaling pathway was sufficient to cause axon sorting. In addition, the generation of cAMP, a downstream product of the G protein pathway, was key to establishing axonal identity. Contrary to the previous theory that axon sorting was independent of olfactory receptor activation, these results suggest that the *G α s* pathway is the critical link that helps guide olfactory neurons to their proper place in the brain. — M.M.

“A G protein/cAMP signal cascade is required for axonal convergence into olfactory glomeruli” by Alexander T. Chesler, Dong-Jing Zou, Claire E. Le Pichon, Zita A. Peterlin, Glennis A. Matthews, Xin Pei, Michael C. Miller, and Stuart Firestein (see pages 1039–1044)

ANTHROPOLOGY

North China's earliest crops

With one of the world's longest-lasting agriculture systems, northern China is one of the major regions where agriculture first began. Gyoung-Ah Lee *et al.* report that millet, not rice, was the most important crop in ancient times for feed and trade in this region. Lee *et al.* carbon-dated charred plant remains from sediment samples obtained throughout the Yiluo valley of northern China. The samples of crops, plants, and weeds dated from 6000 to 1300 B.C. The authors found that foxtail millet was grown during the early Neolithic era and was the principal crop for at least four millennia. Growth of broomcorn millet was far less significant. Rice appeared in the area by 3000 B.C. but never became a predominant crop in this region, which is relatively drier than other parts of China. After rice, wheat became a significant crop between 1600 and 1300 B.C. Few signs existed of any nuts or fleshy fruits. Local weeds were mostly grasses that diversified over time and were probably fodder for domesticated animals. Lee *et al.* say that northern China's farming tradition of mostly dry crops, such as millets, wheat, legumes, and a little rice, appears to have been established at the latest by 1300 B.C. These findings provide insight into how agriculture and civilization first developed in China. — P.D.



Ancient lambsquarter (*Chenopodium*), a common annual, weedy plant, from northern China site.

“Plants and people from the Early Neolithic to Shang periods in North China” by Gyoung-Ah Lee, Gary W. Crawford, Li Liu, and Xingcan Chen (see pages 1087–1092)