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Science Concentrates

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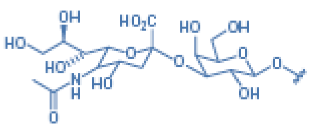
Why bird flu doesn't readily spread



So far, patients infected with the deadly H5N1 bird flu virus have rarely passed the virus to others. The molecular explanation for this observation hinges on the anatomical distribution of two closely related sugar structures found on the surface of cells that line the human respiratory tract, according to a team led by Yoshihiro Kawaoka of the University of Wisconsin, Madison (*Nature* **2006,** *440*, 435). Influenza viruses bind to host cell receptors that contain complex carbohydrates tipped with sialic acid. Avian flu viruses prefer to bind to receptors that display sialic acid linked to galactose by an α-2,3 linkage (shown), whereas human flu viruses prefer the α-2,6-linked version. Kawaoka's team used fluorescently labeled lectins specific for these two linkages to study the sugars' anatomical distribution in the human respiratory tract. They conclude that the bird virus tends to bind to cells deep in the lungs, whereas human viruses prefer to bind cells higher up in the airway, from which they readily can be spread by sneezing and coughing. A Dutch team has reported similar findings using a more direct technique (*Science*, published online March 23, dx.doi.org/10.1126/science.1125548).

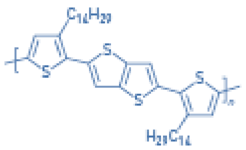
Weighing next to nothing

In the never-ending quest to measure, analyze, tweak, and otherwise engage ever smaller amounts of stuff, Michael L. Roukes and his colleagues at Caltech have devised a nanoelectromechanical system device capable of "weighing" masses in the zeptogram (zg = 10^{-21} g) range (*Nano Lett.*, published online March 15, dx.doi.org/10.1021/nl052134m). The device's sensing elements are diminutive beams of silicon carbide clamped on each end to larger SiC bases, which then integrate with the rest of the device's electronics. The beams, 150 nm wide and 2,300 nm long, are set to vibrate at multi-megahertz frequencies. When the researchers use a tiny nozzle to puff small plumes of xenon or nitrogen at the device, the beam's flexing frequency slows a tad, but enough that the researchers can detect masses as low as 7 zg, which corresponds to about 30 xenon atoms or individual peptides several tens of amino acids long. Among the potential applications for molecular-weighing devices like these are ultrasenstive detectors of chemical and biological warfare agents.

Intracellular zinc detector

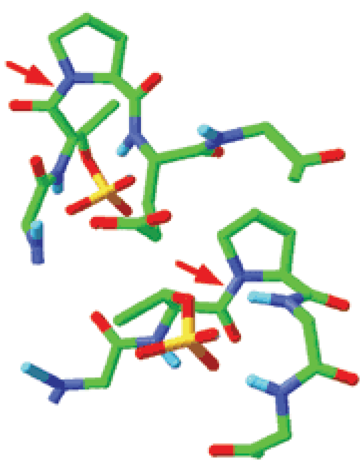
Zinc plays both physiological and pathological roles in biology, and its concentration in eukaryotic cells is estimated to be as high as 200 µM. Because most of this zinc remains tightly bound to proteins, chemists have long wondered exactly how much "free" or exchangeable zinc is actually available. Now, a team led by Richard B. Thompson of the University of Maryland School of Medicine and Carol Fierke of the University of Michigan, Ann Arbor, has developed a sensor to directly image and quantify zinc in resting mammalian cells (*ACS Chem. Biol.* **2006,** *1*, 103). They use their sensor to estimate that the rat tumor and hamster ovary cells they tested are approximately 5 pM in free zinc. This value is significantly higher than the femtomolar concentrations proposed for bacterial cells. The zinc biosensor is based on fluorescence resonance energy transfer from a zinc-bound aryl sulfonamide to a fluorophore tethered to a cell-permeable version of carbonic anhydrase, an enzyme that's highly selective for and sensitive to zinc.

Polymers have display potential



A new type of semiconducting polythiophene with high charge-carrier mobility could potentially be used in flexible, lightweight, and ultimately large-area displays, according to Iain McCulloch and Martin Heeney at Merck Chemicals, Southampton, England, and coworkers. They designed the polymers (example shown) to assemble into large crystalline domains from a liquid-crystal phase (*Nat. Mater.*, published online March 19, dx.doi.org/10.1038/nmat1612). "This exceptional crystallinity gives rise to a dramatic improvement in performance relative to other semiconducting polymers," McCulloch says. When fabricated as thin films, the polymers exhibit extremely well oriented and closely packed polymer backbones. Their extended planar π-electron systems allow close intermolecular π-π distances, which facilitate charge-carrier mobilities equivalent to those of amorphous silicon, the current material of choice in large-area electronics.

Enzyme plays dual role in Alzheimer's



Tau proteins and amyloid-β peptides aggregate to form tangles and plaques in the brains of Alzheimer's disease patients. Back in 2003, Kun Ping Lu of Harvard Medical School showed that the enzyme Pin1 limits formation of tau tangles. Now, Lu and colleagues have found that Pin1 also curbs formation of amyloid plaques (*Nature* **2006,** *440*, 528). The group found that Pin1 binds to a phosphorylated threonine/proline segment of amyloid precursor protein in a way that favors its conversion from a cis (top) to a trans (bottom) conformation (red arrow indicates isomerized bond). The trans conformation of amyloid precursor protein is then clipped by other cellular enzymes into fragments useful for neuronal growth and survival. The cis conformation, on the other hand, is processed into fragments that include toxic amyloid-β peptides. The findings suggest that "lack of sufficient Pin1 enzyme may be a key culprit in the onset of Alzheimer's disease," Lu says.

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