Biology

From New Orleans at the annual meeting of the Society for Neuroscience

Just do it (but only if you want to)

Everyone assumes that exercise is invariably good for the body, but animal studies offer a less rosy picture. Exercise in lab animals often suppresses the immune system. Investigators now believe this odd finding stems from the fact that such animals are compelled to exercise. Mice forced to run a treadmill raise a much weaker antibody response to a foreign protein than do mice willingly running the same amount. "The benefits of exercise are reaped under voluntary conditions," says Monika Fleshner of the University of Colorado at Boulder.

Giving animals no choice but to run triggers stress-related physiological changes that impair the immune system. "The animals that voluntarily exercise showed none of the changes associated with chronic stress," says Fleshner. —*J.T.*

What do platypuses dream of?

During REM sleep, named after the rapid eye movement observed during this phase of slumber, people dream and, scientists suspect, memories consolidate. In a surprising development that may challenge theories of why REM sleep arose, researchers have found that the platypus, considered one of the world's most primitive mammals, spends up to 8 hours a day in REM sleep, more than six times the amount that people experience. "They're REM sleep champions," says Jerome M. Siegel of the University of California, Los Angeles and Sepulveda Veterans Affairs Medical Center.

Siegel and his colleagues at the University of Queensland in Brisbane, Australia, made this discovery by recording eye movement, muscle activity, and brain wave activity in four captive platypuses. Videos of the sleeping animals clearly showed their closed eyes moving rapidly.

Platypuses belong to a rare branch of mammals, the egg-laying monotremes. Studies of the only other two monotreme species had suggested that the animals don't have REM sleep, implying that it evolved after monotremes diverged from the other two mammalian branches, marsupials and placentals.

The platypus sleep study questions that idea. "REM sleep didn't evolve relatively recently in the mammalian line," says Siegel. Since birds also experience REM sleep, the phenomenon may date back 250 million years, to when the last common ancestor of birds and mammals lived. Previously, says Siegel, researchers thought that birds and mammals evolved REM sleep independently. Moreover, since he believes that REM sleep is an old evolutionary development, Siegel suspects that it arose to aid very basic brain stem functions rather than for dreaming or helping memory. —*J.T.*

Thanks, Ma, my brain needed that

Here's a compelling reason to remember Mother's Day next year: Infant mice deprived for just a single day of their mother's attention sustain greater than normal amounts of brain cell death during their postnatal development.

Scientists conducting maternal deprivation studies have long been able to induce permanent changes in the behaviors of animals, notably their responses to stress. Seeking to explain these changes, Mark A. Smith of Dupont Merck Research Labs in Wilmington, Del., and his colleagues separated infant rats from their mothers for 24 hours and then examined their brains for signs of apoptosis, a process in which cells commit suicide.

Apoptosis normally eliminates many cells as the brain establishes its complex wiring pattern. Yet the investigators found twice as many brain cells were undergoing apoptosis in the maternally deprived rats as in the infant rats kept with their mothers. They suggest that the lack of a mother's attention may permanently alter infant brain development, much as visual problems during infancy can disrupt brain regions devoted to vision. —*J.T.*

Physics

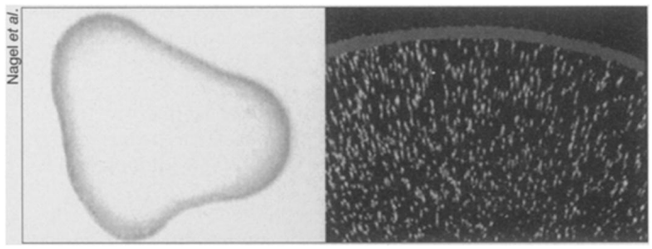
Ringing up a coffee stain

When a spilled drop of coffee dries on a countertop, it leaves behind a powdery residue concentrated in a ring marking the drop's edge. The stain's distinctive appearance suggests the action of some physical or chemical process that segregates particles, initially dispersed throughout the entire drop, as the liquid evaporates. Conventional mechanisms such as diffusion, convection, and wetting fail to account for the phenomenon.

Robert D. Deegan, Sidney R. Nagel, and their coworkers at the James Franck Institute of the University of Chicago have now discovered that the widespread effect is due to a particular type of capillary flow. The edge of the drop typically gets pinned in place by surface irregularities, so liquid evaporating from the edge, where the drop is thinnest, must be replenished by liquid streaming in from the drop's interior. "The resulting outward flow can carry virtually all of the dispersed material to the edge," the researchers report in the Oct. 23 NATURE.

To demonstrate the effect and test their mathematical model, Deegan and his colleagues suspended polystyrene spheres, 1 micrometer in diameter, in a water droplet on a glass microscope slide. They then tracked the concentration and motion of the spheres as the water evaporated and the spheres collected at the drop's edge.

Because the measurements fit their model, ring deposition can be predicted and controlled without knowing the chemical nature of the liquid, the particles, or the surface, the researchers say. Indeed, ring deposits are common wherever drops containing dispersed solids evaporate on a surface. The phenomenon may someday serve as a method for printing a thin line or depositing a fine pattern on a surface. —*I.P.*



A drop of coffee about 2 centimeters in diameter dries up to leave a ring of solid particles outlining the original droplet shape (left). Trails in video micrographs show that tiny polystyrene spheres suspended in water move toward the drop's edge as the water evaporates (right).

Chemical analysis with atom tweezers

Using the scanning tunneling microscope, researchers can determine the locations of individual atoms on a wide variety of surfaces. However, the technique doesn't allow them to identify the type of atom at a particular site. That limits the technique's usefulness in studying atomic impurities, for example, which may be trapped at a surface kink and could influence such processes as crystal growth.

Now, physicists have developed an instrument that allows them to transfer a small cluster of atoms from a surface to a spectrometer for identification. As the needlelike end of a scanning tunneling microscope rides over a surface, a short voltage pulse pulls atoms from the surface to the tip. Applying a much larger voltage pulse to the collected sample ionizes the atoms and sends them flying. Measuring the time the atoms take to reach a detector gives the ratio of their mass to electric charge, permitting researchers to identify them.

Uwe Weierstall, John C.H. Spence, and their coworkers at Arizona State University in Tempe described their technique last month at an American Vacuum Society meeting in San Jose, Calif. —*I.P.*