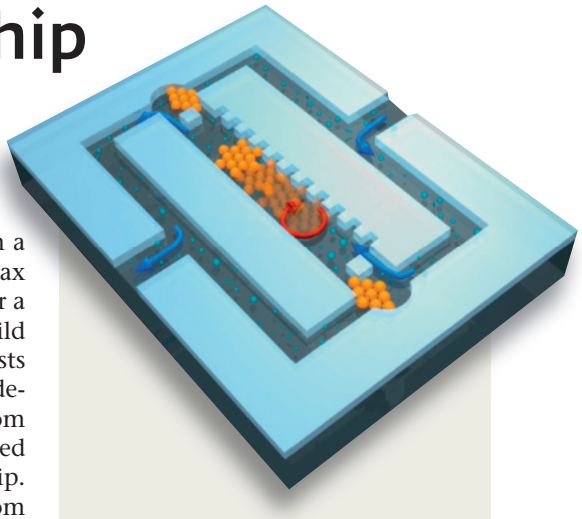
The Ship-in-a-Bottle Microchip

Remote controlled with a magnetic field, aggregates composed of plastic particles on a microchip act as stirrers or pumps.

It would be cheaper to analyze blood samples or DNA on a microchip than in a traditional laboratory. A team of researchers that included scientists from the Max Planck Institute for Metals Research constructed valves, a pump and a stirrer for a laboratory on a microchip. To do this, they used a trick similar to that used to build a ship in a bottle. In the same way that model makers postpone erecting the masts and the rigging until the vessel is in the bottle, the scientists do not put the devices together until they are in the tiny appliance. Working with researchers from the University of Stuttgart and the Colorado School of Mines, they introduced magnetizable colloid particles – tiny plastic spheres – into the spaces on the chip. Then they used a magnetic field to construct diamond shapes or cog wheels from the particles and start them moving. In order to force the spheres to come together into the machine component the scientists want to create, the geometry of the spaces must be chosen very carefully.

Analysis on microchips requires only very small samples, which would reduce costs. Furthermore, it would be possible for doctors to carry out investigations at the scene of an accident, because devices with this microtechnology could easily be accommodated on board emergency vehicles. (PNAS, December 5, 2008)



Pumps team up and work together: In a magnetic field, the microspheres (orange) form diamond-shaped valves and a cog wheel. With skillful manipulation of a magnetic field, the wheel rolls through the cavity and coacts with the valves to create a pump.

A Silent Gene Fattens Flies

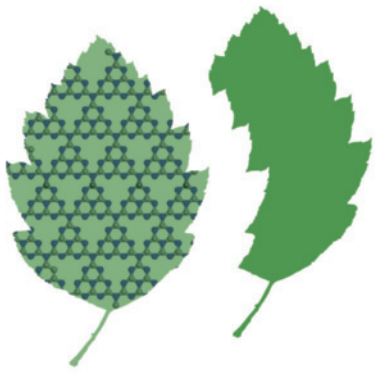
To find out the function of a gene, or rather of the protein that it produces, biologists switch it off. This is how researchers at the Max Planck Institute for Biophysical Chemistry and the National Institutes of Health in Bethesda, USA discovered a protein complex in the fruit fly, *Drosophila*, that plays a key role in regulating the metabolism of fat. This complex, which is made up of at least seven sub-units, appears to act on the surface of fat-storing lipid droplets, where it controls a kind of gate function with other proteins. If the complex is missing because the gene has been switched off, the flies do not break down the fat in the lipid droplet. Because the same protein complex also exists in mice and clearly has a similar effect, it is hoped that it will also be shown to exist in human cells, thus providing a new approach for the treatment of obesity.
(PLOS Biology, November 25, 2008)

A Water-Splitter in a Double Role

While great hopes are pinned on hydrogen, it also presents some problems. It is energy-rich, clean and, in the form of water, of almost unlimited supply. To date, however, it has proved difficult to extract it.

Scientists at the Max Planck Institute of Colloids and Interfaces have now found a simple, low-cost way to produce hydrogen. They irradiate water with sunlight and use one of the oldest artificial polymers as a cheap photocatalyst – a very stable carbon nitride that was first manufactured by Justus Liebig as early as 1834. Previously, inorganic semiconductors and expensive precious metals such as platinum were required to produce hydrogen from water using light. The semiconductor acts as an antenna for the light, and the precious metal as a catalyst.

The carbon nitride now performs both functions at the same time, proving that the process works in principle with an organic catalyst – although up to now, this has been significantly less efficient than the traditional method. In a slightly altered experiment, the carbon nitride also extracts hydrogen from water when it is irradiated with sunlight. The Max Planck researchers are now trying to combine the two reactions, imitating photosynthesis in plants. (Nature Materials, January 2009)



Plants use the energy in sunlight to synthesize sugar. Max Planck researchers hope to copy this process using the net-like structure of carbon nitride.

Graphic: Designergold (below), Sabri Rahmouni – University of Stuttgart (top)