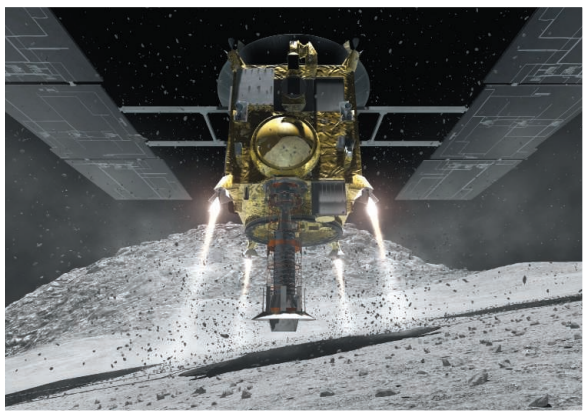
Asteroid Dust Solves Color Conundrum

This year the first samples returned from another planetary body in 35 years settled a decades-old planetary mystery: why the most common meteorites that fall to Earth didn't seem to come from the most common asteroids in the asteroid belt. It turns out they do. By examining bits of asteroid Itokawa brought back by Japan's Hayabusa spacecraft, researchers discovered that the solar wind had been discoloring asteroids enough to cause a massive case of mistaken identity.



Made it! Touchdown on Itokawa, as portrayed in the Japanese movie *Hayabusa: Back to the Earth.*

Hayabusa's odyssey to and from the 535-meter-long Itokawa was as harrowing as anything in Homer. En route, the spacecraft lost two of its three gyroscopelike reaction wheels that controlled its attitude, so it had to fall back on small rockets normally used for course corrections. A tiny rover meant to explore Itokawa's surface instead wound up being launched into deep space. Before the return trip, the spacecraft's attitude-control thrusters sprang a fuel leak; the spacecraft lost its proper orientation, breaking off communications, losing solar power, short-circuiting its batteries, and sinking into a deep freeze.

In a stunningly successful rescue mission, Hayabusa's controllers managed to pull the spacecraft back from the brink of disaster. It returned in June 2010, 3 years late and carrying only a dusting of Itokawa particles—but that was enough. Analyzing 52 particles, each less than 100 micrometers in diameter, Japanese researchers showed that the elements and minerals that make up Itokawa—a member of the largest class of asteroids, the S types—match the composition of the most abundant type of meteorite, ordinary chondrites. Researchers had long been inferring the composition of asteroids from their remotely recorded spectral colors. But the S types looked too red to be the source of the ordinary chondrites. Sophisticated spectroscopic analyses eventually showed that the tint was misleading and the link real. This year, Hayabusa's wispy cargo of asteroid dust closed the case for good.

Probing further, researchers used scanning transmission electron microscopy to look beneath the surface of Itokawa particles. There they could see tiny "nanoblobs" of metallic iron small enough to scatter sunlight and redden the asteroid's surface. Most of the nanoblobs probably formed when charged particles such as protons blowing in the solar wind penetrated the particles on Itokawa's surface. Mission accomplished, Hayabusa.

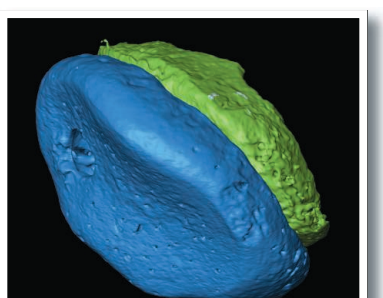
Archaic Humans' DNA Lives On

The past 100,000 years used to seem so simple: *Homo sapiens* arose in Africa, then swept out into Europe and Asia, replacing Neandertals and the other archaic peoples they met there. Fossils and stone tools, bolstered by mitochondrial DNA studies, suggested that the African newcomers did not mate with those ancient humans.

In the past year, however, new analyses of the nuclear DNA of ancient and living humans—including whole genomes—suggests that our ancestors did indeed dally with the locals they supplanted. A flurry of papers has shown that most people alive today carry traces of archaic DNA from those unions.

The new wave of studies started in May 2010, when the Neandertal genome suggested that Europeans and Asians have inherited 2% to 6% of their nuclear DNA from Neandertals. Then at the tail end of December 2010, researchers published the whole genome of a new kind of archaic human from Denisova Cave in Siberia. Follow-up studies found that a "patchwork quilt" of people living in Southeast Asia have inherited about 5% of their DNA from the Denisovans, as well as 4% to 6% from Neandertals. Two teams found Denisovan DNA in Australian aboriginals. One study found it in Negritos in the Philippines and on some islands of Southeast Asia, as well as in Melanesians.

This fall, researchers found that members of three relatively isolated groups of Africans also carried unusual DNA variants apparently inherited from archaic people in Africa in the past 35,000 years, long after modern humans arose. Paleoanthropologists—including one who once championed "complete replacement"—proposed that a 13,000-year-old partial skull from Nigeria represented a descendant of either modern-archaic mixing or a lingering archaic population.



Bred in the bone. DNA from a Siberian finger bone showed mixing between Denisovans and *Homo sapiens.*

Faced with evidence that our African ancestors interbred with archaic humans at least three times in far-flung parts of Asia and Africa, many researchers now favor a "leaky replacement" scenario. Some of the archaic DNA we acquired may have been beneficial: Another study this year concluded that more than half of the gene variants that code for human leukocyte antigen system proteins, which help the immune system recognize pathogens, came from archaics.

Also in 2011, remarkably complete fossils from South Africa opened a window into the still-murky period 2 million years ago when our genus, *Homo*, arose. The species *Australopithecus sediba* has traits found in early *Homo*. Still unsettled: whether *Au. sediba* is our direct ancestor, or one of the many extinct humans who once shared our world.

CREDITS (TOP TO BOTTOM): *HAYABUSA: BACK TO THE EARTH*/HAYABUSA DOME-MOVIE PRODUCTION COMMITTEE; MAX PLANCK INSTITUTE FOR EVOLUTIONARY ANTHROPOLOGY

Published by AAAS

Plant Life's Boxy Heart

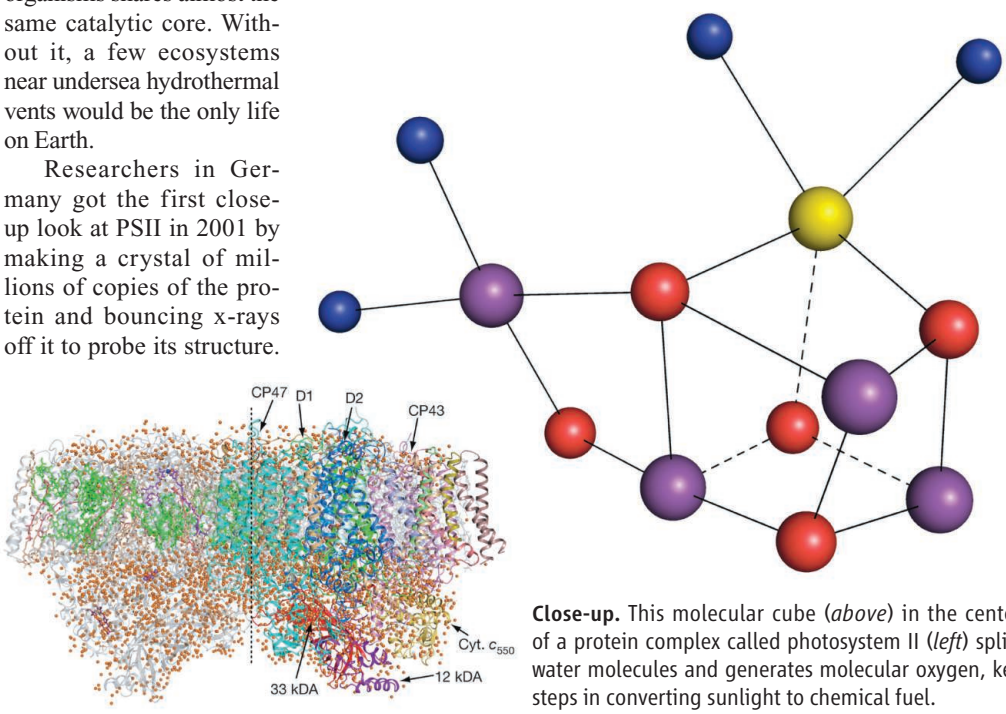
There's not always more than one way to skin a cat. Take the way plants use sunlight, water, and CO_2 to synthesize the sugars they need to grow and multiply. Early in the process, an essential protein called photosystem II (PSII) uses solar energy to split water into hydrogen and oxygen atoms, then pairs oxygens into the O_2 molecules we breathe. Despite billions of years of evolution, PSII in all photosynthetic organisms shares almost the same catalytic core. Without it, a few ecosystems near undersea hydrothermal vents would be the only life on Earth.

Researchers in Germany got the first close-up look at PSII in 2001 by making a crystal of millions of copies of the protein and bouncing x-rays off it to probe its structure. Such crystallography experiments can map complex proteins in near-perfect atomic detail. But the early maps of PSII were too fuzzy to show the exact arrangement of atoms in the core.

The maps got better in 2009. And this year, researchers in Japan captured the protein in full, exquisite detail—including its heart of four manganese atoms, five oxygen atoms, and a calcium atom. The snapshot revealed that these core atoms form a cube with a short tail hanging off one end. That shape, it turns out, is critical for holding pairs of oxygen atoms close enough together to be knitted into O_2.

This structure isn't just essential for life; it may also hold the key to a source of clean energy. Today's societies rely almost exclusively on fossil fuels for energy because we can't match plants' ability to convert sunlight into chemical fuels. Yes, we can use solar cells to make electricity—but electricity is tough to store in mass quantities. Researchers around the globe are racing to come up with catalysts to do the job. One option is splitting water to generate O_2 and molecular hydrogen (H_2), which can be burned or run through a fuel cell to produce electricity. Researchers have created numerous catalysts to split water and generate O_2. And so far the best ones have nearly the same cubic arrangement of atoms at their core as PSII. Knowing the structure of nature's catalyst may help scientists design better synthetic ones.

Researchers nailed down crystal structures of several other important proteins this year. But PSII's structure offers a window into a catalyst that is essential not only for past and present life on Earth but also perhaps for the future of civilization.



Close-up. This molecular cube (*above*) in the center of a protein complex called photosystem II (*left*) splits water molecules and generates molecular oxygen, key steps in converting sunlight to chemical fuel.

CREDITS (TOP TO BOTTOM): Y. UMENA, K. KAWAKAMI, J.-R. SHEN AND N. KAMIYA; ADAPTED FROM Y. UMENA *ET AL.*, *NATURE* **473** (5 MAY 2011); YUHUAN WANG/THE CELL: AN IMAGE LIBRARY

Areas to Watch

The Higgs boson

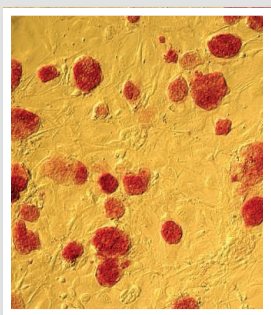
We've said this before (in 2008), but this time we're sure: Next year, particle physicists will either find the long-sought Higgs boson or prove that it does not exist, at least not with the properties ascribed by the standard theory. That's not so much a prediction as it is a matter of fact. The world's largest atom smasher, the Large Hadron Collider at the European particle physics laboratory, CERN, near Geneva, Switzerland, is cranking out data at such a stupendous rate that—barring breakdown—the Higgs must either make an undeniable appearance or be deemed an unequivocal no-show. It's all but a mathematical certainty.

Faster-than-light neutrinos

This year, physicists with the OPERA particle detector rocked the world when they reported that subatomic particles called neutrinos made the 730-kilometer trip between CERN in Switzerland and Italy's subterranean Gran Sasso National Laboratory at slightly faster than light speed. Researchers with the MINOS experiment, which shoots neutrinos from Fermi National Accelerator Laboratory in Batavia, Illinois, to the Soudan mine 735 kilometers away in Minnesota, say they will try to reproduce the result by early 2012. Don't be surprised if it takes a little longer—and if neutrinos do not really fly faster than light.

Stem-cell metabolism

The way stem cells use energy and intermediate metabolites seems to help determine when they differentiate and what kinds of cells they become. In 2012, look for researchers to use large-scale studies of stem cell metabolism to gain new insights into how stem cells regulate themselves in the body—and how scientists might tweak the process in the lab or in patients.



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Glimpses of a Simpler Time

The universe was born thrashing and flailing. You'd think that exploding stars and other cataclysms would have roiled every corner of the cosmos within a couple of billion years. But it turns out that pockets of tranquility persisted. This new insight, based on two discoveries reported this year, is making astronomers rethink the details of star formation in the young universe.

One discovery, reported in November, is the sighting of pristine clouds of hydrogen. The clouds match the chemistry of much older primordial gas from the first few hundred million years after the big bang, before stars formed. The other discovery is a small star in the Milky Way's halo whose concentration of "metals" (elements heavier than helium) is about 1/10,000 that of the sun. This star is practically devoid of metals, just like the universe's earliest stars, which are believed to have been hundreds of times as massive.

The results add a twist to the story of the universe's chemical evolution. When the universe began, researchers believe, it was made up of gas containing light elements, mostly hydrogen and helium. The first stars formed from this material, some 300 million years after the big bang. As these early stars burned their fuel, they fused the lighter atoms to produce heavier elements like carbon and oxygen. These so-called metals spewed into interstellar space when the stars exploded as supernovae. The birth and death of later generations of stars, made from gas polluted with these heavier elements, added even more heavy elements into the mix, making the overall chemistry of the universe increasingly metal-rich. Today, the stars and planets and interstellar gas around us are laced with heavy elements.

Pristine. Clouds of gas discovered this year—possibly trapped in filaments between galaxies, as shown in this computer simulation—may be surprisingly long-lasting leftovers from the big bang.

Astronomers used the Keck telescope to probe the faraway universe, dating back to a mere 2 billion years after the big bang, for relatively pristine gas clouds. To figure out the clouds' chemical composition, they studied the spectrum of a background quasar whose light had traveled through the gas on its way to the telescope. They searched for signs of oxygen, carbon, nitrogen, and silicon but saw only hydrogen and its heavier isotope deuterium.

The star discovered by the other team was equally surprising because astronomers thought low-mass stars could form only from material with a certain concentration of metals. The reason is that metals are considered necessary for helping to cool a gas cloud enough to condense into a star.

The two results suggest that the first few generations of exploding stars did not scatter heavy elements throughout the universe like a captive squid filling its tank with ink. Instead, pockets of pristine gas lingered for billions of years, and some may have seeded a late crop of small, metal-free stars.

CREDITS (TOP TO BOTTOM): SIMULATIONS BY CEVERINO, DEKEL, AND PRIMACK; NASA/JPL-CALTECH

Genomic epidemiology

Not long ago, sequencing a single bacterium's genome took years; now the job takes less than a day. Scientists are beginning to harness that power to track pathogens' movements in more detail than ever before. Whole-genome sequences will help to determine quickly where newly emerging diseases come from, whether microbes are resistant to antibiotics, and how they are moving through a population; they will also shed light on historic epidemics.

Treating intellectual disability

The cognitive deficits and behavioral problems caused by Rett, Fragile X, and Down syndromes have long been considered irreversible. In each syndrome, a genetic glitch causes brain development to go awry even before birth. But recent work with mouse models of these conditions suggests, remarkably, that some cognitive and behavioral symptoms may be reversible. Treatments that target growth factors or neurotransmitter receptors in the brain are now in human clinical trials, and preliminary results should start to emerge in 2012. Meanwhile, expect preclinical researchers to keep coming up with new targets.

Curiosity to Mars

NASA will have more than the $2.6 billion cost of the Mars Science Laboratory (MSL) mission riding on a successful landing on the Red Planet next August. MSL's new "entry-descent-landing" system—designed to lower the 900-kilogram nuclear-powered Curiosity rover gently onto the martian surface—is essential to NASA's ambitious plans to return rock samples to Earth. It is engineered to achieve the pinpoint landings on Mars needed to collect specific samples and return them on a later mission. Failure of the landing system on its first voyage would be disastrous for much more than Curiosity.

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Scorecard

Rating last year's Areas to Watch

The Large Hadron Collider

This year, the world's largest atom smasher had its first real chance to reveal new particles and new phenomena. We predicted that the first big results would arrive not from the LHC's two biggest particle detectors, ATLAS and CMS, but from the smaller LHCb detector—which was expected to test previously seen hints of new physics in the behavior of particles called B_s mesons. Alas, it hasn't yet. And neither LHCb nor the other three LHC detectors have seen incontrovertible proof of new physics—a fact that makes some scientists nervous.

Adaptation genes

In 2011, many ecologists and evolutionary biologists started using faster, cheaper sequencing technologies to search for genes and gene activity patterns that help organisms thrive in nature. Researchers discovered genes that underlie mimicry in butterflies, and several papers revealed how the plant *Arabidopsis* is adapting to climate change. But most of these efforts have not yielded the promised gene finds—yet.

Laser fusion

Some things are hard to rush, and getting a self-sustaining fusion burn at the National Ignition Facility is turning out to be one of them. Researchers at Lawrence Livermore National Laboratory in California are still working to get the world's highest energy laser pulse to squeeze deuterium and tritium until their nuclei fuse. Some researchers fear it may never work, but Livermore's finest are working through the problems one at a time and remain confident of success.

Hammering viruses

More and better immune-system generalists—so-called broadly neutralizing antibodies—came to light in 2011. These antibodies disable a wide range of flu and HIV variants instead of targeting just a specific one, providing hope for broad-ranging vaccines. After defining the structure of one such antibody that targets HIV, one group improved on its potency, a first step toward clinical value. Others have determined what these antibodies bind to on the virus. But no one has figured out which viral proteins or sugars prompt the formation of these antibodies in the body. That's what's needed for a vaccine.

Electric vehicles

Change can be a tough sell. A year ago we suggested that sales of new mass-market plug-in electric vehicles could be sluggish due to concerns about the vehicles' limited range. And so they were. Nissan sold more than 20,000 copies of its new Leaf, while Mitsubishi, Chevy, and Tesla combined for about another 25,000. Not a bad start, but it's still paltry beside the roughly 17 million vehicles sold in just the United States every year. And the feds' new inquiry into the safety of the Chevy Volt's lithium-ion batteries won't help.

Malaria shots

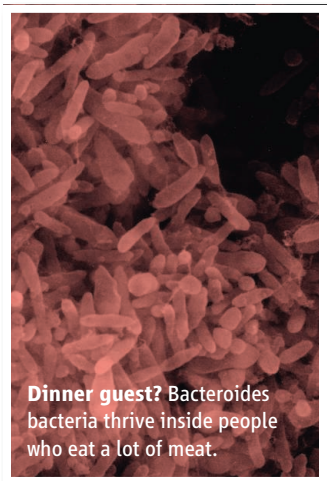
The results of the first phase III trial of a malaria vaccine came out in October. They met the modest expectations raised by phase II studies and were hailed as a milestone for this notoriously difficult research field, despite the vaccine's shortcomings (see p. 1633).

Microbes R Us

OVER THE PAST SEVERAL YEARS, STUDIES HAVE REVEALED AN astonishing diversity in our so-called microbiome. Portfolios of resident microorganisms vary from individual to individual—even twin to twin—and from body part to body part. Researchers were left scratching their heads over whether they would ever make sense of the composition of these communities or show how they affect human health.

In 2011, researchers discerned a pattern amid the complexity. A European consortium evaluated the gut microbial makeup of 22 Europeans using differences in a bacterial gene to distinguish the species within and between individuals. They compared these microbiomes with about a dozen previously characterized in Japan and the United States.

Far from being random, our internal microbial communities fell roughly into three enterotypes, which the researchers dubbed *Bacteroides*, *Prevotella*, and *Ruminococcus* after the dominant microbe in each. The gut microbiomes from larger samples of 154 Americans and 85 Danes also fit well into three groups, indicating that there are a limited number of well-balanced communities in the human gut. The classifications weren't correlated with people's age, weight, sex, or nationality. Each enterotype differed in how it processed energy and in which vitamins it produced, factors that could influence the health of the human host.



Dinner guest? Bacteroides bacteria thrive inside people who eat a lot of meat.

More work is needed to confirm that enterotypes are real. Meanwhile, another team found that types seem to correlate with diet. For example, *Bacteroides* thrived on high-meat diets; *Prevotella* did well with vegetarian fare. Neither enterotype was affected by 10 days of dietary restrictions, suggesting that they are more influenced by long-term eating trends.

This year, researchers also made other strides in understanding how diet affects the microbiome. They introduced 10 human gut bacteria into germ-free mice and monitored the composition of the bacterial community as the mice consumed different proportions of protein, fat, starch, and sugar. The results suggested rules for predicting how a change in food will alter the abundance of each species. The approach will help clarify the interplay between diet and microbes in nutrition and disease.

Several other studies provided more clues about the microbiome's role in disease, development, and immune function. Going even smaller, researchers continued to characterize the virome: all the viruses of the body. Far from being alien invaders, our microbes are integral to who and what we are.

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RTS,S—A Vaccine With Many Maybes

Here's the glass-half-empty view: The biggest trial ever of a malaria vaccine showed that it reduced severe disease in young children by less than half—a poor performance compared with vaccines for many other diseases. Researchers don't know how long the children will be protected; immunity might wane in a matter of years. The price of the new vaccine isn't known yet, but it could be hefty. Nobody knows whether the vaccine will ever be used in Africa, where it is most needed, or who might foot the bill.

And here's the opposite view: After decades of bitter disappointments in the malaria vaccine field, the results seen in smaller trials of this vaccine, called RTS,S, have held up. True, the vaccine by itself won't end malaria, and perhaps it will be used in only a small number of places—but at least researchers have shown that it's possible, and they can build on the modest success to design something better. Despite the uncertainties, this makes the first results of the phase III clinical trial of RTS,S, published in October, a runner-up for the Breakthrough of the Year.

The trial is a massive, ongoing operation at 11 sites in seven African countries from Ghana to Mozambique. It has enrolled more than 15,000 children in two age groups: 6 to 12 weeks and 5 to 17 months. Produced by GlaxoSmithKline (GSK) in collaboration with the PATH Malaria Vaccine Initiative, the RTS,S vaccine has received more than $200 million in development support from the Bill and Melinda Gates Foundation.

Just how frustrating the malaria vaccine field is was driven home by results of another trial published this year. Hopes were high for that candidate, developed by a U.S. company named Sanaria, but only two out of 44 participants were protected. Animal studies show that it might work better when injected intravenously rather than under the skin, as in the study, offering a new ray of hope. But the vaccine is produced by letting the parasites grow in mosquitoes, killing them with radiation, and then harvesting them by manually picking apart the mosquitoes' bodies—a fascinating but cumbersome approach.

The results with RTS,S, which consists of a recombinant protein, leave plenty of questions as well. The vaccine could just delay the first episode of severe malaria, not prevent it. GSK has promised to keep the shots as cheap as possible but refuses to give even a ballpark price. A World Health Organization panel will issue recommendations for use in 2015, when all of the data are in. If the vaccine is introduced, it will surely complement other, low-tech measures that already exist but aren't terrific either, such as bed nets. Meanwhile, the modest success with RTS,S is inspiring a generation of follow-up candidates, but those will be years and many millions of dollars away. In malaria prevention, nothing seems to come easy.

Extrasolar? Extra Strange

For planetary scientists, it has been like falling asleep in Kansas and waking up in Oz. For centuries they based their understanding of planetary systems on the only one they knew: our solar system. Now, with more than 700 extrasolar planets on record, researchers are grappling not only with planets unlike anything circling our sun but also with entire planetary systems whose weirdness is forcing scientists to rethink how planets form and settle into orbits.

The first such system to make a splash this year was reported in February. Searching through data from NASA's Kepler observatory—which has been tracking 156,000 nearby stars for dips in brightness due to transiting planets—astronomers found six large planets, at least three of them gas giants like Jupiter, orbiting a star named Kepler 11 some 2000 light-years from Earth. Five of the six are bunched up very close to the star, closer in than Mercury is from the sun. The sixth planet lies only a bit farther out, as far as Venus is from the sun.

Astrophysicists have two theories about how massive planets form within the whirling disk of gas and dust that extends out from a rotating star. One holds that large planets form relatively far from their parent star and move in over time; the other says that such planets remain where they form. The Kepler 11 system confounds them both. Modelers can't explain how five big planets could have all drifted in so close to the star, or how there could have been enough solid material to seed their formation right where they are now.

Other oddities reported this year include HAT-P-6b, a gas giant orbiting in a direction opposite to the spin of the parent star. The discovery adds to a growing list of exoplanets with such "retrograde" orbits. Because planets arise from a disk of material rotating around a star, their orbits are expected to follow the star's spin. But computer simulations reported this year showed that the gravitational pull of another planet or a brown dwarf farther out from the host star can yank a planet out of its original orbit and into a new one that slants across the star's equatorial plane. The orbit gets tilted farther and farther, until at some point it flips.

Odd balls. Other stars' planets can be wildly different from those near us.

This year, scientists also reported sighting an exoplanet orbiting a binary star system—another surprise that calls for new models of planetary formation. And other researchers used gravitational microlensing to find 10 planets floating freely in space with no host stars nearby, suggesting that they may have been kicked out of the planetary systems in which they formed.

These discoveries are providing new clues about the chaos and violence that planetary systems likely undergo before settling down into an orderly routine. So far, at least, there really is no place quite like home.

CREDITS (TOP TO BOTTOM): GILBERT AWEKOFUA/PHOTOSHARE; NASA/AMES/JPL-CALTECH

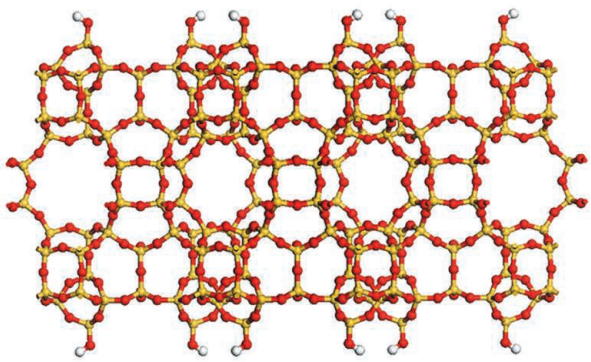
Published by AAAS

Industrial Molecules, Tailor-Made

If you ever doubt that chemistry is still a creative endeavor, just look at zeolites. This family of porous minerals was first discovered in 1756. They're formed from different arrangements of aluminum, silicon, and oxygen atoms that crystallize into holey structures pocked with a perfect arrangement of pores. Over the past 250 years, 40 natural zeolites have been discovered, and chemists have chipped in roughly 150 more synthetic versions.

This abundance isn't just for show. Three million tons of zeolites are produced every year for use in laundry detergents, cat litter, and many other products. But zeolites really strut their stuff in two uses: as catalysts and molecular sieves. Oil refineries use zeolite catalysts to break down long hydrocarbon chains in oil into the shorter, volatile hydrocarbons in gasoline. And the minerals' small, regularly arranged pores make them ideal filters for purifying everything from the air on spaceships to the contaminated water around the nuclear reactors destroyed earlier this year in Fukushima, Japan.

Zeolites have their limitations, though. Their pores are almost universally tiny, making it tough to use them as catalysts for large molecules. And they're difficult to form into ultrathin membranes, which researchers would like to do to enable cheaper separations. But progress by numerous teams on zeolite synthesis this year gave this "mature" area of chemistry new life.



Assembly required. Porous zeolite crystals are widely used as filters and catalysts. This year, researchers found new ways to tailor the size of their pores and create thinner, cheaper membranes.

Researchers in South Korea crafted a family of zeolites in which the usual network of small pores is surrounded by walls holed with larger voids. That combination of large and small pores should lead to catalysts for numerous large organic molecules.

Labs in Spain and China produced related large- and small-pore zeolites by using a combination of inorganic and organic materials to guide the structures as they formed.

Meanwhile, researchers in France and Germany discovered that, by carefully controlling growth conditions, they could form a large-pore zeolite without the need for the expensive organic compounds typically used to guide their architecture as they grow. The advance opens the way for cheaper catalysts.In yet another lab, researchers in Minnesota came up with a new route for making ultrathin zeolite membranes, which are likely to be useful as a wide variety of chemically selective filters.

This surge of molecular wizardry provides a vivid reminder that the creativity of chemists keeps their field ever young.

Removing Old Cells to Stay Young?

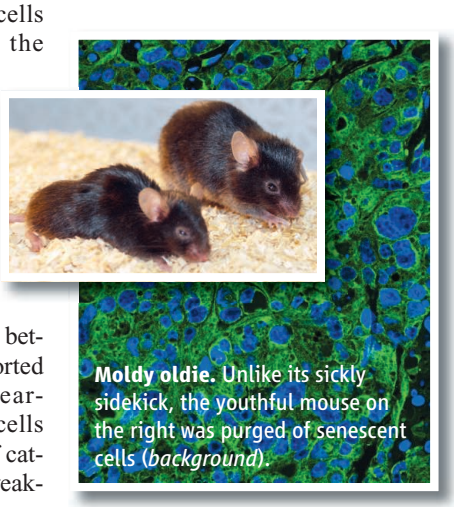
Washed-up cells loitering in our tissues help make us old, scientists hypothesize. This year, researchers provided solid evidence that these cells promote aging and that culling them could keep us healthier longer.

Certain cells in our bodies divide again and again, spawning replacements that help refurbish our tissues. But these cells can also become liabilities because they often accumulate genetic damage that fosters cancer. So after reproducing a limited number of times, the cells call it quits, undergoing what's termed cellular senescence. They remain alive but lose the ability to divide—and presumably to found tumors.

The hitch is that senescent cells aren't necessarily the self-sacrificing good citizens they appear to be. They have some bad habits, leaking growth-stimulating and tissue-dissolving chemicals that encourage tumors to grow and spread. Senescent cells' misdeeds might also promote aging in several ways, such as by damaging the surrounding tissue or by stoking the protracted inflammation characteristic of old age. But pinning down the details has been difficult.

To find out more, researchers used genetic engineering and crossbreeding to create a line of mice with two features. The animals died young, developing age-related complications such as cataracts, feeble muscles, and stiff arteries early in life. And injections of a particular drug triggered the animals to kill off cells that manufacture the protein $p16^{INK4a}$, which flags many senescent cells and helps curtail their division.

Mice that received the drug didn't live longer than normal, but they did seem to live better. As the team reported in November, clearing out senescent cells delayed the onset of cataracts and muscle weakness. Compared with their brethren, treated mice could scurry for a longer time on a treadmill and perform more strenuous workouts. The injections also prevented the dwindling of body fat, another problem for the elderly. Some age-related complaints, such as stiff arteries, didn't appear to respond, probably because they don't result from accumulation of senescent cells that produce $p16^{INK4a}$.



Moldy oldie. Unlike its sickly sidekick, the youthful mouse on the right was purged of senescent cells (*background*).

Even if the mice didn't start receiving the drug until they showed signs of aging, it provided some benefits. That finding is heartening, implying that if scientists devise a compound to purge senescent cells from people, it would help more than just the young.

That's a big if, of course, but the work raises the possibility that targeting senescent cells or countering their effects could burnish our golden years.