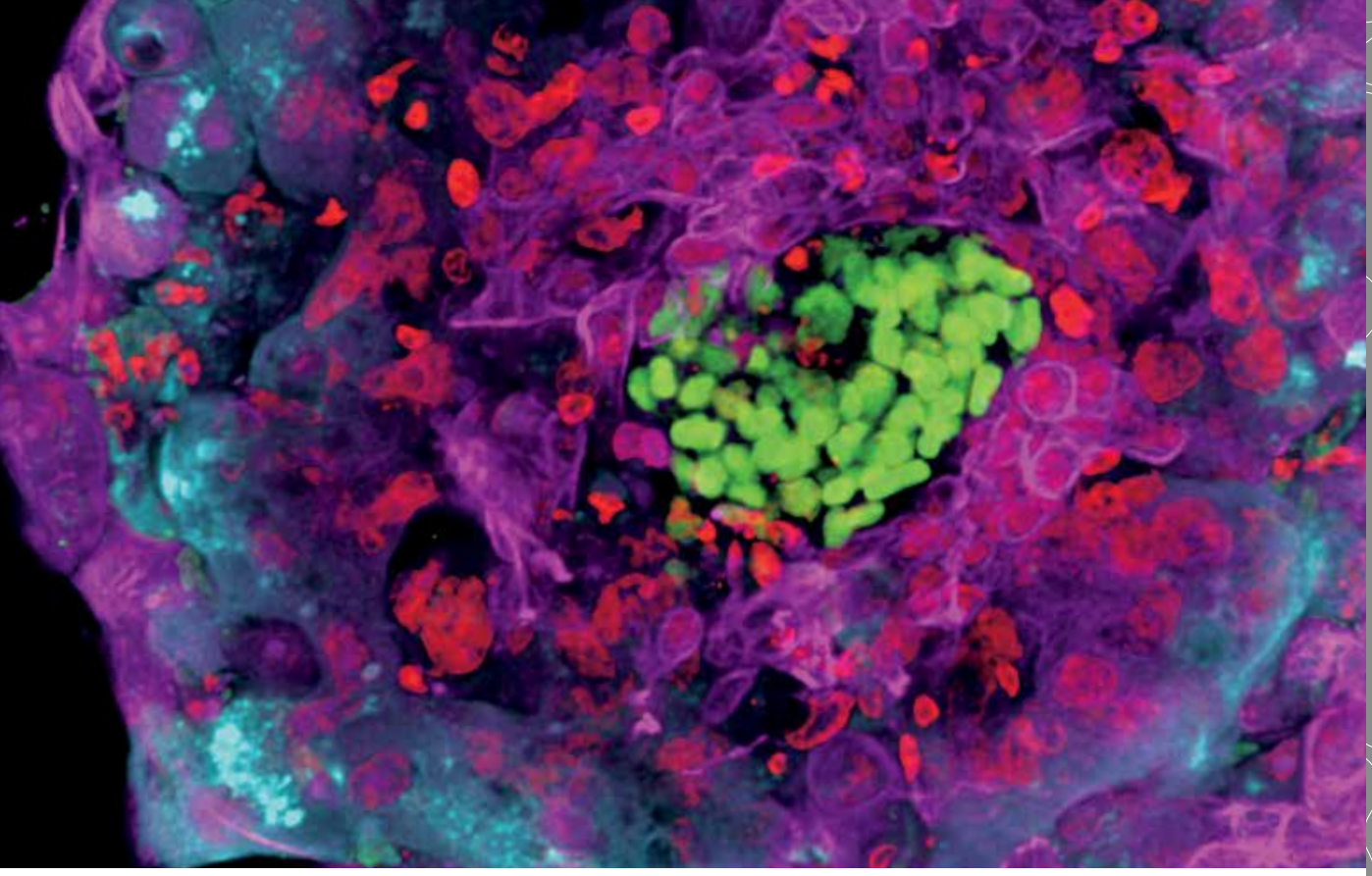


Rockefeller tops international rankings of scientific productivity and impact. These are a few of our most notable 2016 discoveries.

▲ DEVELOPMENTAL BIOLOGY

Human embryos break barriers

The very earliest stages of human development, just after fertilization, are the hardest to observe, yet arguably the most critical to an embryo's viability. By surrounding a nascent human embryo with just the right chemical environment, and providing a suitable scaffolding for it to attach to, scientists successfully guided its development in a petri dish until 14 days after fertilization. The breakthrough—previous attempts to culture human embryos faltered after just a few days—has given scientists their first look at the process of implantation outside of the uterus.

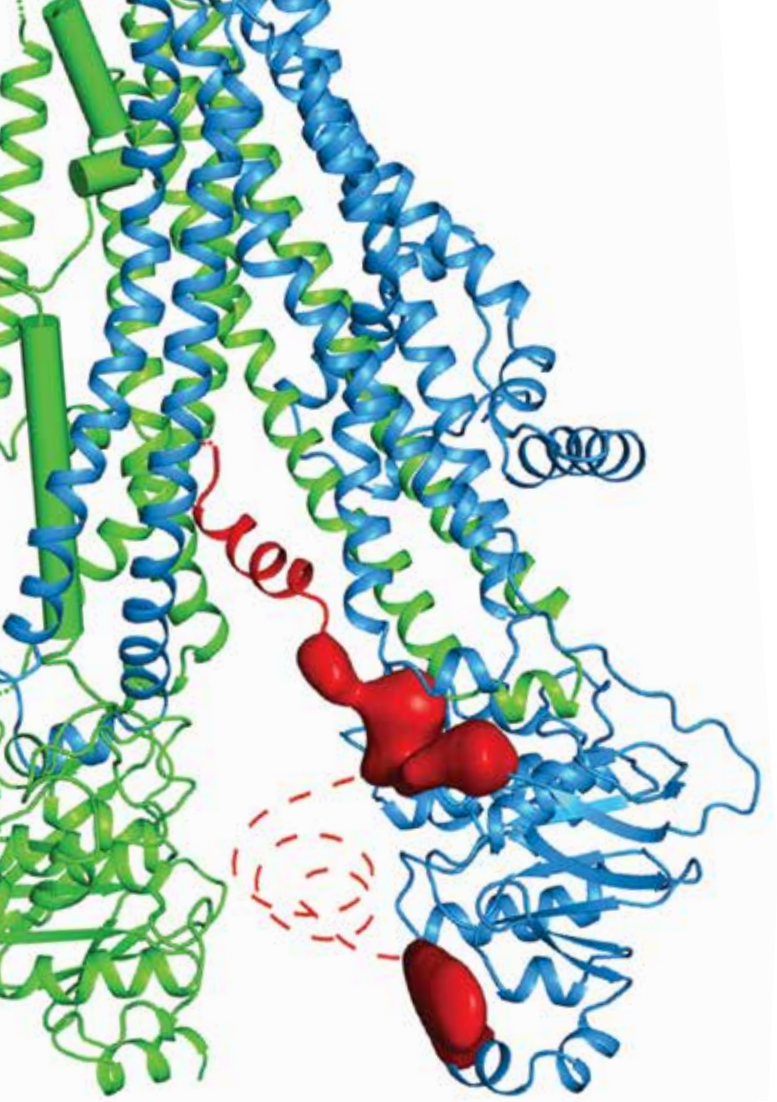
In addition to insights into the molecular details of this process, the findings, from **Ali H. Brivanlou**, have clinical implications for understanding why early miscarriages occur and why in vitro fertilization often fails.

INFECTIOUS DISEASE

Probiotics as antibiotics

Antibiotics are great at killing bacteria, but they tend to kill indiscriminately. A gentler, and potentially more effective, strategy is to use probiotics, which alter the microbial balance within a host to quell the most problematic bugs. Although the approach is not new, **Daniel Mucida** and **Howard C. Hang** found that it may have untapped potential. Their studies show that introducing specific "good" bacteria into colonies of mice and worms can prevent *Salmonella* from causing disease by spurring the production of proteins that protect the hosts' tissues. They also identify the specific genes and pathways involved.

The research could help battle antibiotic resistance, and it has particular promise for the fight against *C. difficile*, a persistent intestinal bug that sickens nearly 500,000 people in the United States each year and kills more than 29,000.



HIV

New HIV drug gets a human trial

A new biologic agent based on antibodies—the most potent of its kind so far—showed early promise in its first clinical trial. The drug, 10-1074, is part of a class of molecules known as broadly neutralizing antibodies, which are naturally found in HIV-infected people whose immune systems have a rare ability to fight off the virus.

The study, from **Michel C. Nussenzweig**, found that among 13 HIV-infected people who received the highest dose of 10-1074, 11 showed a rapid decline in the amount of virus in their blood. Additional findings from HIV-negative participants suggest it may also be an effective way to prevent infection in people at risk of acquiring the virus.

BIG DATA

Using math to predict smells

Without using your nose, it's hard to say what something will smell like, even if you know its exact chemical composition. A project initiated by **Leslie B. Vosshall**, and powered by crowdsourced teams of data analysts from around the world, has yielded a mathematical model that can forecast the scent a molecule will evoke.

The model is based on over one million data points from human sniffers, who rated 476 different molecules in each of 19 descriptive classifications, and two million additional data points describing chemical features of the molecules. The project is a step toward associating the input of a chemical structure with the output of an odor, and could help shed light on the enormously complex biology of smell perception.

◀ STRUCTURAL BIOLOGY

Cystic fibrosis under the microscope

Thanks to photographs of nearly a million frozen molecules, captured using cryo-electron microscopy and compiled by powerful computers, there's now a three-dimensional model of the protein responsible for cystic fibrosis, an inherited lung disease for which there is no cure.

Jue Chen's work on the cystic fibrosis transmembrane conductance regulator (CFTR), which is involved in the movement of ions into and out of cells, has yielded the locations of 53 disease-causing mutations and revealed a particularly vulnerable spot that appears responsible for many cases of the disease. By addressing what goes wrong at this site, she hopes scientists will be able to devise treatments.

BIOTECHNOLOGY

Bacterial DNA as data storage

Even bacteria have an immune system of sorts—a genetic mechanism by which viral invaders can be detected and eliminated based on their "memories" of past attacks, stored as snippets of DNA. In nature, however, the recording events by which these memories are formed happen quite rarely.

Luciano Marraffini identified a mutation that allows bacteria to form such memories far more frequently. The memory-boosting technology promises to enhance gene-editing tools such as CRISPR, already a powerful system for inserting and removing specific segments of DNA for experimental purposes. It could also someday spawn a sort of biologic recording system capable of capturing critical information about biological events such as neural activity or cancer metastasis.