

## Areas to watch in 2015

Science is a moving target. In addition to looking back on achievements of the previous year, the Breakthrough staff also hazards a few informed guesses about developments likely to make news in months to come.

### ARCTIC SEA ICE

As the world heats up, so does research into far-reaching consequences of shrinking Arctic sea ice. Sea ice loss is already known to amplify warming in the region, as the open ocean absorbs more energy from the sun. But what impact the warming Arctic has on lower latitude weather—and whether it is to blame for some of the weather extremes of the past decade, from Asian monsoons to European winters—is still hotly debated. Identifying long-distance connections within the complex dynamics of atmospheric circulation is no easy task. This year, scientists proposed a few patterns to watch, including large-scale Rossby waves and the polar jet stream. In 2015, expect efforts to pin down how they might exert an Arctic influence on weather thousands of miles south.

### SOLAR SYSTEM ENCOUNTERS

The year of the comet came in 2014. But 2015 is apt to be the year of the dwarf planet. In March, NASA's Dawn spacecraft will arrive at Ceres, the largest object in the asteroid belt and one that contains a surprising amount of ice. Four months later, in July, NASA's New Horizons spacecraft will speed past Pluto in a brief but momentous encounter. The two icy bodies are twins of a sort. In 2006, the International Astronomical Union upgraded Ceres from an asteroid to a dwarf planet and demoted Pluto from a planet to a dwarf. Some scientists have proposed that both objects were created when icy cometesimals clumped together in the outer reaches of the solar system, then wound up in wildly different places, perhaps tossed there by the gravitational shenanigans of a roving Jupiter. The two missions should go a long way toward sorting out the origin stories.

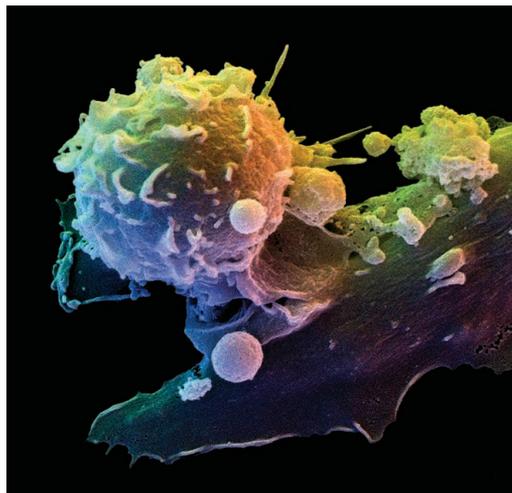
### LHC RESTART

Next spring, the Large Hadron Collider (LHC) at CERN, the European particle physics laboratory near Geneva, Switzerland, will power up after 2 years of repairs. In July 2012, the LHC blasted out the Higgs boson, the last piece in physicists'

standard model of the known particles. But some researchers say that if accelerator-based particle physics is to have a future, the massive machine will have to discover something beyond the tried-and-true standard model. Now the LHC is back for another try, at energies expected to be nearly twice as high as in the first run. Look to see whether the LHC finally reaches its design energy—and whether, in the next few years, it discovers new mysteries to sustain the field.

### COMBINED IMMUNOTHERAPY

Cancer immunotherapy, *Science's* Breakthrough of 2013, continues to surge as clinical researchers amass evidence that the immune system can be a powerful ally against tumors. One big focus



Combination therapies that help harness T cells and other immune cells in the cancer fight are a key area to watch.

now is mixing and matching treatments: combining two novel immunotherapies, for example, or an immune strategy with a targeted drug, radiation, or chemotherapy. Dozens of clinical trials are under way—ranging from a phase I study in melanoma that combines the recently approved immunotherapy drug ipilimumab with another treatment that slows blood vessel growth, to a phase III trial testing whether ipilimumab and chemotherapy outperform chemotherapy alone in treating lung cancer. The results could make it easier for oncologists to match treatments to patients. But potential toxicity of the new strategies remains a concern.

## Breakdown of the year: Ebola

This year, an Ebola outbreak that began in the remote Guinean village of Meliandou grew into a widespread epidemic that has alarmed the entire world. Outpacing efforts to contain it, the virus has ravaged Guinea and neighboring Liberia and Sierra Leone, creating a public health breakdown that Margaret Chan, director-general of the World Health Organization (WHO), described as “likely the greatest peacetime challenge that the United Nations and its agencies have ever faced.”

Ebola outbreaks have flared every few years since the virus was first identified in 1976. Yet until now, containment efforts derailed all outbreaks within a few months and kept them mostly remote and local, limiting the total number of cases to only 2500 or so. This time around, the virus spread across borders and through crowded cities, taking advantage of shaky health systems and a slow, uncoordinated international response to grow into an epidemic that has sickened more than 18,000 people and killed nearly 7000 so far, with isolated cases as far afield as Spain and the United States. “I wonder whether one person in the world could say that he or she predicted this outbreak,” says Bertrand Draguez, the medical director for Doctors Without Borders (MSF) in Brussels. Its future course is equally unpredictable.

After the first case in Meliandou in December 2013, it took 3 months for health officials to realize an Ebola outbreak was under way. MSF quickly sent in teams, and by late March, the virus had spread to four districts in Guinea, and Liberia and Sierra Leone had suspected cases. “We are facing an epidemic of a magnitude never before seen,” MSF warned on 31 March. But over the next month and a half, the outbreak waned and even Guinea's president declared the situation “well in hand.”

By mid-June, however, the number of cases in the three countries had skyrocketed to 504, surpassing the largest previous outbreak. MSF announced it no longer had enough staff to keep up



Overwhelmed by Ebola in August, Monrovia converted this primary school classroom to an isolation ward. The health care worker is disinfecting a corpse.

with the spread. Wobbly health care systems in the three countries—which long had suffered from political instability, corruption, and staggering poverty—began to collapse. Overwhelmed clinics had no beds for the sick, who returned home and infected others.

The problem still drew little international attention until two American missionary health care workers became infected in late July. On 8 August, WHO declared the epidemic a “public health emergency of international concern.” A month later, U.S. President Barack

Obama announced that the country would send in 3000 military troops to help, millions of dollars of aid poured in, and an aggressive push emerged to develop Ebola drugs and vaccines.

Finger-pointing escalated in lockstep with the case counts. WHO and the international community took too long to act. No one effectively coordinated responses. Local governments played ostrich, fudged case reports, and imposed counterproductive quarantines. Frightened health care workers stayed away from work. Affected

communities attacked aid workers and ostracized survivors. Sick people refused to go into isolation or divulge their contacts. Some cultures resisted changing dangerous burial practices.

Over and above those factors, the region’s permeable borders and extensive transportation routes have complicated contact tracing and expanded the epidemic’s reach. More vexing still, the sudden surges of patients in ever-changing locales have meant a constant shortage of trained doctors, nurses, janitors, ambulance drivers, and gravediggers.

Although Liberia has recently made progress in some places, Draguez, who recently visited 10 Ebola treatment units MSF runs in the three affected countries, says the end is nowhere in sight. “We have to keep on going with the same level of energy for 6 or 8 or even 12 months,”

he warns. Already the Ebola epidemic of 2014 has made it starkly clear that we must move steadily and aggressively against this virus, or it will continue to teach us lessons we do not want to learn.

—Jon Cohen

**“I wonder whether one person in the world ... predicted this outbreak.”**

**Bertrand Draguez,**  
Doctors Without Borders

## Breakdown runners-up

Unfortunately, there’s always more than enough bad news to fill this category. A few of this year’s notable flaps, stumbles, and reverses.

### STEM CELLS MADE EASY?

Rarely has so dazzling a claim gone down in flames so quickly. In January, researchers from Japan and the United States published what purported to be an easier, more powerful new method for turning adult cells into stem cells. But within 3 weeks, online commentators spotted questionable images in the two papers. Doubts multiplied as other labs around the world tried and failed to repeat the feat. Lead author Haruko Obokata was found guilty of misconduct, *Nature* retracted the papers, and in a tragedy that shook the field, one co-author took his own life. Officials in Japan radically reorganized the RIKEN institute where most of the work was done, cutting staff from more than 500 to 250.

### GLIMPSE OF CREATION?

In March, cosmologists working with a specialized telescope at the South Pole called BICEP2 claimed they had spotted in the afterglow of the big bang a sure signal that the newborn universe had undergone a bizarre growth spurt known as inflation. Others suggested the signal could have come from dust within our own galaxy, and in September, researchers with the European Space Agency’s Planck spacecraft showed that most or all of it probably does. The two teams are working on a joint analysis, but the bold claim seems unlikely to hold up.

### LAWMAKERS VERSUS NSF

Is the science committee for the U.S. House of Representatives broken or simply doing its job as watchdog? The U.S. research community watched with dismay this year as the committee, led by Representative Lamar Smith (R-TX), pummeled the National Science Foundation and other federal science agencies at hearings, in press releases, and with subpoenas and legislation. Smith says he’s making sure the government spends tax dollars wisely. His actions have captured headlines, but many scientists—remembering the bipartisan, big-picture policy discussions that used to be the panel’s bread and butter—might prefer a return to quiet obscurity.

# Science

## Breakdown + Breakdown runners-up

*Science* **346** (6216), 1450-1451.  
DOI: 10.1126/science.346.6216.1450-b

ARTICLE TOOLS <http://science.sciencemag.org/content/346/6216/1450.2>

RELATED CONTENT <http://science.sciencemag.org/content/sci/346/6216/1442.full>

PERMISSIONS <http://www.sciencemag.org/help/reprints-and-permissions>

Use of this article is subject to the [Terms of Service](#)

---

*Science* (print ISSN 0036-8075; online ISSN 1095-9203) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. 2017 © The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works. The title *Science* is a registered trademark of AAAS.