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BRILLIANT MINDS FORECAST THE NEXT 50 YEARS

New Scientist celebrates **50 years** 

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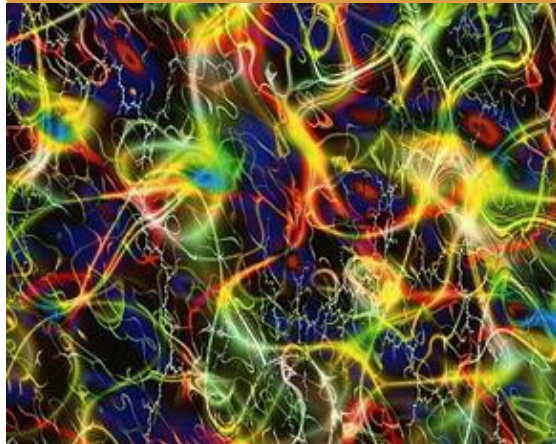
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TOP STORY



Alexander Vilenkin forecasts the future

Cosmic strings, relics of the hot, high-energy early universe, might well be discovered, allowing us to directly test superstring theory

EXPERT GUIDE

Instant Expert: Brilliant Minds Forecast the Next 50 Years

What will be the biggest breakthrough of the next 50 years? As part of our 50th anniversary celebrations we asked over 70 of the world's most brilliant scientists for their ideas.

In coming decades will we: discover that we are **not alone in the universe**? Unravel the physiological basis for **consciousness**? Routinely have **false memories implanted** in our minds? Begin to **evolve in new directions**? And will physicists finally hit upon a universal **theory of everything**? In fact, if the revelations of the last 50 years are anything to go on - the internet and the human genome for example - we probably **have not even thought up** the exciting advances that lay ahead of us.

Delve into those visions of the future by author in the story list of this **special report**, or navigate forecasts by topic here:

Life: **Ageing, alien life, consciousness, ecology, embryology, environment, evolution, genetics, health, humans, language, neuroscience, oceans, psychology, sex and social science.**

Space and technology: **Artificial intelligence, communications, computing, cosmology, space and technology.**

Physical sciences: **Chemistry, energy, materials, maths and physics.**

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What will be the biggest breakthrough of the next 50 years?

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ARTICLES

Alexander Vilenkin forecasts the future

Cosmic strings, relics of the hot, high-energy early universe, might well be discovered, allowing us to directly test

Benoit Mandelbrot forecasts the future

The creator of the famous Madlebrot Set believes the fractal geometry of roughness is set to expand rapidly, carving

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superstring theory

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Steven Weinberg forecasts the future

The Nobel prize-winning physicist predicts the discovery of a final theory that dictates all properties of particles and fields

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Paul Davies forecasts the future

The director of a new cosmic think tank is passionate about alien life, and suspects we may well find it soon

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Sydney Brenner forecasts the future

He won the Nobel prize for medicine. Now he predicts major advances in our understanding of the biology of the most interesting species - us

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Lewis Wolpert forecasts the future

As systems biology and computer models progress, the development of embryos will eventually become fully "computable"

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John D. Barrow forecasts the future

Cosmologists have much to look forward to: the direct detection of dark matter and gravitational waves, to name but two

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Francis Collins forecasts the future

If the genetic advances that Collins foresees come to pass, entire generations of us will be living happily into our hundreds

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Gerard 't Hooft forecasts the future

The Nobel prize-winning theoretical physicist looks forward to the uniting of quantum mechanics, gravity, and the evolution of the universe

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Max Tegmark forecasts the future

In 50 years, you may be able to buy T-shirts on which are printed equations describing the unified laws of our universes

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Frans de Waal forecasts the future

Disentangling the feedback loop between brain development and the ancient primate tendencies that shape our societies will be a huge advance

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Edward O. Wilson forecasts the future

The biggest leap in biogeography and conservation biology will be the near-complete mapping of global biodiversity at the species level

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Marcus du Sautoy forecasts the future

The next 50 years hold the real prospect that we might finally reveal the secrets behind prime numbers

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Steven Pinker forecasts the future

"I absolutely refuse even to pretend to guess how I might speculate about what, hypothetically, could be the biggest breakthrough of the next 50 years"

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Rocky Kolb forecasts the future

The most significant breakthrough in cosmology will be the discovery of background gravitational waves produced in the very early universe

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Richard Miller forecasts the future

In ageing research, the key breakthrough will be the

itself an important role in science

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Eric Horvitz forecasts the future

By 2056 the computational revolution will be recognised as a transformation as significant as the industrial revolution

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Paul Nurse forecasts the future

Within 50 years it should be possible to provide mechanistic explanations of the intricate self-regulating nature of the cell, the basic unit of life

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Ray Kurzweil predicts the future

By 2029 we will create computers that pass the Turing test, with formidable results, claims the inventor and writer

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Philip Zimbardo forecasts the future

The best is yet to come for psychology says Stanford University's Philip Zimbardo

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Robert Ballard forecasts the future

The oceanographer and discoverer of the Titanic thinks that high-bandwidth fibre optic cables could literally "wire the world"

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Fred Gage forecasts the future

Within 50 years, neuroscientists will have developed a non-invasive device that measures brain activity in real time, in free-living humans, says the Salk Institute professor

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Roger Gosden forecasts the future

Technology has the potential to conquer infertility, birth defects and genetic disease says the director of research in reproductive biology at the Center for Reproductive Medicine and Infertility, Weill-Cornell Medical College in New York City

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Christof Koch forecasts the future

Machine-brain interfaces will be realised by 2056 says the cognitive and behavioural biologist

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Bruno Latour forecasts the future

In 50 years, social scientists will be able to visualise the connections between human organisations and technological objects says the sociology of science professor

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Michael Marmot forecasts the future

In a world where non-infectious diseases are the major disease burden, the key to understanding and improving health is in the mind says the director of the International Institute for Society and Health at University College London

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Irene Pepperberg forecasts the future

By 2056, we will use birds to understand how human language evolved says the Harvard University psychologist

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Oliver Sacks forecasts the future

The physician and writer looks forward to a general theory of imagination, consciousness and self

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Daniel Schacter forecasts the future

We will uncover the basis and evolution of our memory says the psychologist

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Leonard Susskind forecasts the future

We may discover if the laws of physics are the same throughout the universe or variable says the Stanford

elucidation of the molecular pathways that render cells from long-lived animals so resistant to injury

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J. Richard Gott forecasts the future

Establishing a self-supporting colony on Mars would change world history - it wouldn't even be "world" history any more

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Michael Gazzaniga forecasts the future

The next 50 years will focus on the social mind, the fact that humans are social animals and that most of the time we think about relationships

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Robert May forecasts the future

The significant breakthrough we really need is better understanding of human institutions, particularly of the impediments to useful cooperation

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Lisa Randall forecasts the future

The Large Hadron Collider should tell us more about the underlying nature of matter and how elementary particles acquire mass

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Ellen Heber-Katz forecasts the future

The day is not far off when we will be able to prescribe drugs that cause severed spinal cords to heal, and hearts to regenerate

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Niles Eldredge forecasts the future

The most significant breakthroughs will come in the form of retro-fitting existing advances in molecular and biology to a more integrated synthesis of evolutionary theory

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Daniel Pauly forecasts the future

A device to detect, amplify and transmit to us the emotions and fleeting "thoughts" of animals would be useful, with a view to building our empathy

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Peter Norvig forecasts the future

Google's director of research predicts a growing transformation in the global access to information. Forget search engines as you know them

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Stephen Wolfram forecasts the future

A central theme of the next 50 years will be a systematic exploration of the "computation universe" of all possible programs

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Timothy Gowers forecasts the future

There are about half a dozen problems that almost all mathematicians agree are supremely important

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Martin Rees forecasts the future

The Astronomer Royal hopes that by 2056 we'll know if the laws of physics we know are the only ones there are and if our big bang was unique

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Igor Aleksander forecasts the future

A scientific understanding of consciousness will come from a recognition of the brain as an informational machine

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Bernard Wood forecasts the future

We will know exactly how we evolved to be us and not chimps

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Michael Benton forecasts the future

A near-complete picture of the "tree of life" will reveal rates of evolution and patterns of mass extinctions and of

University Physicist

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Anthony Atala forecasts the future

How about injecting universal donor cells that naturally migrate to an injury site, where tissue repair and regeneration can occur, all without rejection?

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Simon Baron-Cohen forecasts the future

To speculate on the next 50 years in cognitive neuroscience, look at what has emerged over the last five years and multiply by 10

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Gregory Chaitin forecasts the future

By 2056, weird astronomical observations may have led to radical new fundamental physics, and people will be tampering with the human genome, which should be fun

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Simon Conway Morris forecasts the future

The depths of reality are only now being uncovered, but by 2056 the springs of imagination, intuition, abstraction and even pre-cognition are revealed

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Antonio Damasio forecasts the future

The future will no doubt promote advances molecular neurobiology and an understanding of the systems related to cognition and behavior

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Dan Dennett forecasts the future

Cognitive neuroscience will figure out how neural nets in the brain are stitched together to produce the mental activities familiar in cognitive psychology

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Carl Djerassi forecasts the future

A big breakthrough will be the development of an efficient and convenient means of storing a young woman's ovarian tissue or eggs to be used years later

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Freeman Dyson forecasts the future

We have been searching alien life for 50 years and found nothing, but in the next half century we shall discover it

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Jane Goodall forecasts the future

It is now possible to go online and see the world's lush forests and the effects of deforestation - the breakthrough will come in how we act on this information

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Monica Grady forecasts the future

Many theories predict that at least Mars and Europa are suitable hosts for life within our solar system - it will be disappointing if our increasingly sophisticated tools fail to find some

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Susan Greenfield forecasts the future

Brain imaging has revolutionised cognitive neuroscience and diagnostics - in the future we will be able to see changes at the synaptic level that underpin learning

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John Halpern forecasts the future

Increasing use of "psychedelic" drugs may lead to a new field of medicine in which spirituality is kindled to help us accept our mortality without fear

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Piet Hut forecasts the future

The discovery of life elsewhere in the universe would be the most significant breakthrough, not only for astrophysics, but also for biology, philosophy and culture

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diversification

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Andrew Knoll forecasts the future

Most fossils will have been found, but new technologies and a greater focus on physiology will compensate

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Frank Wilczek forecasts the future

The Nobel prize-winner expects a golden age for physics, computers with superhuman intelligence and solar power providing much of our energy

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Geoffrey Miller forecasts the future

Evolutionary psychology will undermine consumer capitalism, foster stronger communities and replace religion with a naturalistic moral philosophy

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Chris McKay forecasts the future

A "second genesis" of life! We may find evidence of alien life frozen in Martian permafrost or on other worlds, perhaps dead but preserved

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Rodney Brooks forecasts the future

How to make artificial intelligences that can recognise and classify objects is something we have struggled with for 40 years - we will crack it

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Lawrence Krauss forecasts the future

Will we discover the mystery behind dark matter by 2056? Possibly, but we will need a brilliant new theoretical idea

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Elizabeth Loftus forecasts the future

Imagine a world where anyone with the correct technique and the right pharmaceuticals can implant false memories into anyone they choose

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Peter Atkins forecasts the future

Computers will continue to illuminate chemistry and the reactions of natural life - eventually we may be able to build synthetic life from scratch

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Sean Carroll forecasts the future

The seconds following the big bang have been described in elaborate detail, but we will hopefully nail down exactly what happened at the awesome moment itself

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Arthur McDonald forecasts the future

The elucidation of dark matter should be the biggest breakthrough of the next half-century, and many tools are already in place to detect it

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Bruce Lahn forecasts the future

Biomedicine will be transformed when we discover the ability to produce unlimited supplies of transplantable human organs

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Terry Sejnowski forecasts the future

Fifty years is about the time it takes for breakthroughs to occur that you cannot anticipate, nevertheless...

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David Deutsch forecasts the future

On the experimental side, the construction of a working, general-purpose quantum computer is what this eminent physicist hopes for

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Nathan Myhrvold forecasts the future

Applied physics will be revolutionised by advances in metamaterials and intricate synthetic structures,

Bill Joy forecasts the future

The most significant breakthrough would be to have an inexhaustible source of safe, green energy that is substantially cheaper than any existing energy source

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Jaron Lanier forecasts the future

In the next 50 years, computer science needs to achieve a new unification between the inside of the computer and the outside

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Charles Nemeroff forecasts the future

Identifying gene variants that confer vulnerability to major psychiatric disorders will result in the emergence of a new field, preventative psychiatry

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Colin Pillinger forecasts the future

We have been promised humans on Mars for so long now that I almost despair that this will be achieved by 2056, but we should at least have brought back Martian samples

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Carolyn Porco forecasts the future

The most significant development in planetary exploration in the next 50 years will be the discovery of either extant or fossilised extraterrestrial life forms on another solar system body

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Carlo Rovelli forecasts the future

Between now and 2056 a coherent way of thinking about the world will emerge, compatible with new discoveries such as quantum theory and relativity

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Steve Squyres forecasts the future

There could be no more significant advance than learning whether there is life elsewhere in the universe - either way, a definitive answer would be profound

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Kip Thorne forecasts the future

Over the next 50 years, gravitational waves from the big bang will be detected, first indirectly by the imprint they leave on the cosmic microwave radiation and then directly

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Alan Walker forecasts the future

In a perfect world, in 50 years we will have found hundreds of beautiful skeletons of those bipedal apes that were the ancestors of modern humans

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Beverly Whipple forecasts the future

In addition to a better understanding of brain activity during sexual response and orgasm, we will hopefully come to the universal acceptance that sexual health is a fundamental human right

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Tim White forecasts the future

The most significant breakthrough in hominid palaeobiology will be the recognition that fossil vertebrates are a limited and non-renewable resource

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Edward Witten forecasts the future

Even if the present cosmological picture remains unchallenged, there will be numerous discoveries involving, for example, extra-solar planets

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Anton Zeilinger forecasts the future

The major breakthrough in quantum mechanics will be to finally understand why nature is such that we have a description that is so enormously successful, yet so counterintuitive

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Lisa Randall forecasts the future

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With the advent of the Large Hadron Collider, the next 50 years should tell us more about the underlying nature of matter and how elementary particles acquire their mass. These insights might provide information not just about particles, but possibly about the underlying nature of space-time. On a theoretical level, tantalising hints of space breaking down at short distances and time breaking down at singularities tell us that fundamentally, space and time are not what we think. Physicists are just beginning to address these issues. Progress should occur in domains where field theory (which combines quantum mechanics and special relativity), cosmology (which studies the evolution of the universe), and quantum gravity (which may or may not be string theory) overlap and reach the edges of their applicability.

Brilliant Minds Forecast the Next 50 Years – find many more in our exclusive *Special Report*. You can also have your say on what the biggest breakthrough of the next 50 years will be, in our **New Scientist Forum**

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