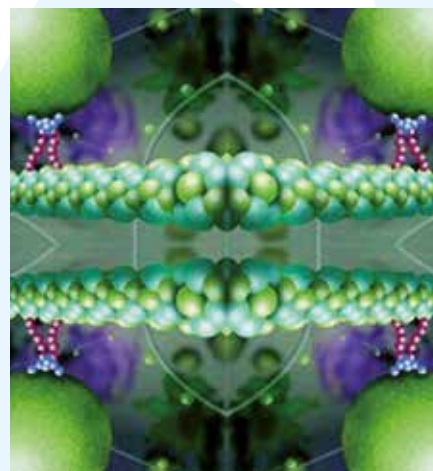




BIOTECHNOLOGY

RESEARCH IN FRANCE

France ranks third in Europe, behind the United Kingdom and Germany, in the number of biotechnology companies operating within its territory. These 400 firms employ about 6,000 people, more than half of whom work in research and development. Biotechnologies are increasingly important in the health sector, but they have a growing role in several other sectors as well—among them the environment, agriculture, and food processing. The energy, materials, and chemical sectors are also influenced by advances in biotechnology.



AN APPLICATION OF SCIENCE AND TECHNOLOGY

Biotechnologies are applications of science and technology to living organisms and their parts. They are based on three properties specific to living things:

- > **Replication** refers to the ability of microorganisms and plant and animal cells to reproduce identical copies of themselves.
- > **Molecular recognition**, which is the focus of the field of immunology, points to the capacity of living things to recognize and eliminate foreign structures and molecules.

> **Enzyme catalysis** is the mechanism by which simple or complex chemical reactions are accelerated by proteins known as enzymes.

The biological tools used in biotechnologies are many: microorganisms (bacteria, yeasts, molds), animal and plant cells, genes, enzymes (extracted from animal or plant tissue or from cultures of microorganisms), antibodies (proteins capable of recognizing molecules that are foreign to an organism).

These biological tools may be improved through genetic or protein engineering, through synthetic biology, or through engineering of biological networks and systems.

VARIED APPLICATIONS

Biotechnology applications are used in a variety of fields: medicine and health (so-called red biotechnologies), food-processing and chemistry (white biotechnologies), the environment (yellow biotechnologies), and agriculture (green biotechnologies).

In the sectors of **human and animal health**, biotechnologies have applications in therapeutics (new medicines), prevention (vaccines), and diagnostics (immunoassays and genetic tests). New products are made from genetically modified organisms. The discovery of new treatments depends increasingly on biotechnology to identify the cause of diseases and to design, test, and produce new medicines.

In **regenerative medicine**, functional living tissues are created to replace or repair damaged tissues and organs or to cure congenital defects and diseases. Here, biotechnologies offer great promise, **as nanotechnology** and biology combine to produce biosensors and "labs-on-a-chip."

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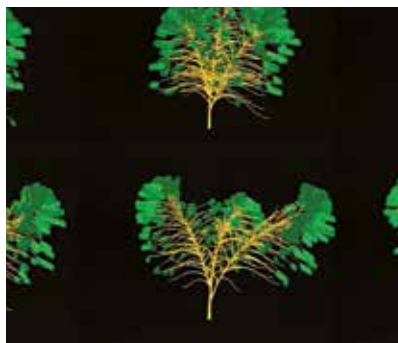
Synthetic biology, which is based on convergences between nanotechnologies, life sciences, and information technology known as NBICs (for nano-bio-info-cogno), finds applications in the bioproduction sector (such as biofuels, materials derived from petrochemistry, and food additives), security (biosensors for the fight against bioterrorism), biomaterials, and so-called smart materials.

White biotechnologies use living organisms (molds, yeasts, bacteria, plants) and enzymes to synthesize **chemical products** for many industries. Enzymes are produced for a variety of **manufacturing sectors** (food products, detergents, paper pulp, textile processing), biodegradable plastics, biomaterials, chemistry, and biofuels.

The **food industry** also uses biotechnological processes, such as on-site fermentation in heterogeneous media using bacteria and yeasts and additions of enzymes often derived from cultures of genetically modified microorganisms.

In the **environmental sciences**, biotechnologies (such as those that take advantage of the purifying power of microorganisms) are used in the industries responsible for wastewater treatment, solid-waste treatment, and soil remediation. Other biotechnologies have figured in the design of sensors used to monitor the state of the environment—for example, to detect the presence of chemical pollutants.

Biotechnologies are an essential part of modern **agriculture**. Improved seed strains are developed using genetically modified organisms. Other applications are in animal selection and in strengthening the resilience of plants. In the realm of cell cultures, micro-algae have many new industrial uses—as sources of food and fuel, for example.



BIOTECHNOLOGIES ARE CENTRAL TO FRANCE'S NATIONAL RESEARCH STRATEGY

> **France's top research priority:
health, well-being, food, and biotechnology.**

AVIESAN, the national alliance for the life sciences and health:
www.aviesan.fr

Founded in 2009, AVIESAN is made up of INSERM (the French national institute of health and medical research), CNRS (the national center for scientific research), CEA (the nuclear and alternative energy commission), INRIA (the national institute for research in computer science and control), the Pasteur Institute, CPU (the conference of French university presidents), and the conference of directors of university hospital centers. Its purpose is to represent France within European and international program agencies.

> **Research priorities**

- **Agriculture and the environment:** Development of biotechnologies that will enable intensive agricultural production while also protecting the environment.
- **Chemistry and energy:** Increased use of renewable carbon from plants, particularly cellulose-rich biomass.
- **Medicine and health:** To support a vigorous biotechnology industry centered on new and innovative companies.
- **Microbiology:** To encourage French research in metagenomics, a new branch of genomics applied to the study of complex microbial systems.
- **Health and biotechnology** are the focus of a government-designated thematic project of excellence. Among the themes of the project are bioresources for the development of agro-industrial biotechnologies, animal and plant selection, and uses for plant and animal biomass, including biomass derived from marine sources.





USEFUL LINKS

- Adebitech, a French biotech think tank: www.adebiotech.org
- AllEnvi (national alliance for environmental research): www.allenvi.fr
- ANSM (national agency for the safety of medicines and health products): <http://ansm.sante.fr>
- Atlanpole Biotherapies, a competitiveness cluster: www.atlanpolebiotherapies.com
- AVIESAN (national alliance for the life sciences and health): www.aviesan.fr
- Biotechnologies France database (fields of activity, research topics, publications): www.biotechnologiefrance.org
- BioValley, a global competitiveness cluster: www.alsace-biovalley.com
- Biotechnology committee of the French federation of medicine producers: www.leem.org
- Cancer Bio Santé, a competitiveness cluster: www.cancerbiosante.fr
- École Supérieure de Biotechnologie de Strasbourg (ESBS): www-esbs.u-strasbg.fr www.leem.org/article/les-biotechnologies
- Eurobiomed, the Mediterranean biocluster: www.eurobiomed.org
- European Federation of Biotechnology: www.efb-central.org
- Formations Biotech, a database of biotechnology programs in France: www.formations-biotech.org
- France Biotech, the Web portal of French biotechnology and the French association for biotechnology: www.france-biotech.org
- France Biotechnologies, a directory of biotechnology and the life sciences: www.francebiotechnologies.fr
- Génopôle biopark (biotechnologies and genetics): www.genopole.fr
- Haut Conseil des Biotechnologies (HCB, the biotechnology council): www.hautconseildesbiotechnologies.fr
- Indigo, a network of European projects in the field of biotechnology and health: www.newindigo.eu/npp/
- Investments in the Future (a French public investment program) – health and biotechnology: <http://investissement-avenir.gouvernement.fr>
- Lyon Biopôle, a global competitiveness cluster: www.lyonbiopole.com
- Medicen Paris region, a global competitiveness cluster of health technologies and new therapies: www.medicen.org
- Nutrition Santé Longévité, a competitiveness cluster: www.pole-nsi.org
- Biotechnology industry portal, French ministry of the economy, finance, and industry: www.industrie.gouv.fr/portail/secteurs/index_biotech.html

General information

- ABG, promoting career opportunities for young PhDs: www.abg.fr
- ANDeS, national association for Science PhD: www.andes.asso.fr
- ANRT, national agency for research and technology: www.anrt.asso.fr
- CNRS, national center for scientific research: www.cnrs.fr
 - Directory of laboratories and researchers: www.cnrs.fr/fr/une/annuaires.htm
 - CNRS international magazine (in English): <http://www2.cnrs.fr/en/2.htm>
- EURAXESS, mobility for researchers in Europe: http://ec.europa.eu/euraxess/index_en.cfm
- Fondation Alfred Kastler, hospitality and support for foreign researchers in France: www.fnak.fr
- Ministry of Higher Education and Research: www.enseignementsup-recherche.gouv.fr
- Oséo Innovation, the French innovation agency: www.oseo.fr
- Website for mobile European researchers in France: www.eurosfair.prd.fr/mobility
- THESA, website for thesis of Grandes Écoles (CGE): <http://thesa.inist.fr>

FRENCH RESEARCH PORTAL

WWW.CAMPUSFRANCE.ORG/EN/RESEARCHER

A UNIQUE, **ONLINE-ACCESS INFORMATION POINT**
FOR LOCATING RESEARCH PROJECTS



◆ UNDERSTANDING FRENCH RESEARCH

- > Understanding how PhDs operate in France;
- > Knowing how to start and finance a PhD;
- > Applying to international research programs (Hubert Curien Partnerships, *Make Our Planet Great Again*).



◆ DIRECTORY OF DOCTORAL INSTITUTIONS

Point of entry for starting a PhD and the 270 doctoral institutes organizing and supervising doctoral training.

- > Search by key words, regions, and disciplines;
- > Comprehensive information on doctoral institutions: Research areas, criteria and points of contacts for admission, welcome mechanisms, proposed topics, current financing, international dimension, and points of contacts for associated research laboratories;
- > Access to fields offered by each doctoral institutions.

58 doctoral schools in biotechnology accessible at:

<https://doctorat.campusfrance.org>

◆ PhD TOPICS, LABORATORY INTERNSHIPS, AND POST-DOCTORAL STUDIES:

- > Offers financed through doctoral contracts, Industrial agreements for training through research (CIFRE), and specific offers devoted to programs financed by foreign governments;
- > Offers for internships for experience in laboratory research;
- > Post-doctoral offers for work in French laboratories;
- > A detailed financing mechanism for each research offer (PhD topics, post-docs, and internships);

Almost 80 offers made public in Biotechnology each year, accessible at:

<https://doctorat.campusfrance.org/phd/offers>