

► The nervous system and its pathologies

Understanding the organization and function of the nervous system is one of the most crucial frontiers of knowledge.

Brains are the result of a long evolutionary process reaching the pinnacle of complexity with humanization. With more than 100 billion interconnected neurons, research in neuroscience, cognitive science, neurology and psychiatry comprise the most complex field of life sciences.

- Understanding the **hierarchical assembly** of **thousands** of **molecular, cellular** and **tissue components** of the nervous system, as well as their **dynamics** and their **plasticity** is essential to decipher the **complexity** of the **functions** of the human nervous system including motor control, sensory perception, learning, decision making, language, symbol manipulation, awareness of being and social interactions.
- In **Europe**, the total cost of brain disorders is estimated at **€800 billion/year** representing a heavier financial burden than cardiovascular diseases and cancer combined. In coming years, as the population ages, these expenses will moreover increase considerably. In addition, a quarter of the population will likely suffer from a brain disorder at one point in their lifetime.



DEVELOPMENT OF NEURAL CIRCUITS.

This image shows a mouse hippocampus labeled using the Brainbow technique. This technique enables the visualization of neuronal circuits by creating a multicolor labeling of the brain. The Brainbow strategy works by targeting expression of random combinations of fluorescent proteins of different colors (cyan, yellow, red...) in neurons. Image made at « l'Institut de la Vision », Paris.

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The strengths and Teams in the field

750 Teams

3,800 Personnel including: Researchers, post-docs, engineers, Technicians, administrative staff and students

18 Clinical Investigation Centers

7,000 Publications per year

120 Million euros of budget (excluding salaries)

- Neuroscience research and its translation into diagnostic and therapeutic measures are of highest priority and represent growing challenge for neurological diseases, neurodegenerative diseases, epilepsy, sleep diseases, multiple sclerosis, stroke, brain tumors, migraines but also psychiatric disorders anxiety, depression, addiction, autism, schizophrenia, obsessive compulsive disorders and deficits of sensory organs, visual, hearing or somesthetic impairments.
- Beyond its benefits to medicine, research on the nervous system will broaden the scope of many other domains including education, innovation, data processing, robotics, security (road, industrial) systems and the general economy.

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Scientific, technological and medical priorities

Promote a multi-scale and interdisciplinary approach by supporting the development of new technologies, particularly in the field of imaging and brain computer interfaces in order to:

- ▶ Decipher the mode of organization of the nervous system, the neural code and identifying the rules of interaction of the human brain with the surrounding world;
- ▶ Understand the neural basis of major sensory, motor, cognitive, emotional and behavioral functions and their disorders;
- ▶ Establish the roles of genetic, epigenetic and environmental factors during the development, the lifetime and the normal aging of the nervous system.

Ensure and facilitate the networking of research facilities (structures) across France and Europe by promoting links between pre-clinical, clinical and industry in order to:

- ▶ Understand the mechanisms underlying neurological, psychiatric and sensory organ diseases so as to model them, to identify therapeutic targets and to better characterize disease subtypes by identifying specific biomarkers;
- ▶ Understand the different stages of disease progression and identify biomarkers of these stages, particularly of the prodromal phase in order to initiate treatment as early as possible;
- ▶ Analyze the risk-benefit ratio of pharmacological and non- pharmacological treatments by studying efficacy and toxicity biomarkers and by examining individual response variations to treatments.

Expert Group

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Visages: vision, action and health information management image analysis of encephalic mri. imaging and neuroinformatics platform "neurinfo", service radiologie irm du chu pontchaillou, Rennes. Unité mixte de recherche: Inserm, Université Rennes 1, INRIA, CNRS, IRISA.

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