The brain is our most complex organ. It enables us to see and how we understand the world, but it remains largely unknown, and is one of the great challenges in biomedical research for the 21st Century.

The many functions that we rely on to live, and appreciate life, are organized by the brain. Keeping it functional implies constant maintenance and consumes large amounts of energy.

Besides other cell types, the brain is made up by around one hundred billion interconnected neurons. The Spanish Researcher Santiago Ramón y Cajal (1852-1934) was the first to identify this complex network that transmits information.

Neurons connect each other via synapses, with one cell releasing chemical signals called neurotransmitters that are interpreted by the following cell. This synaptic transmission release is controlled by electric currents that travel along neurons.

These connections between neurons are not totally fixed, and can be reorganized throughout life. This synaptic plasticity underlies different types of behaviors.

Studying the brain is not easy. We are very different from rodents, and human experimentation is impossible, unless a lesion can suggest the function of the brain region where it occurred.

One well-known example is the case of Henry Molaison (1926-2008), known as Patient HM. After a surgery performed to control his epilepsy, he lost the ability to correctly retain and organize memories.

It is possible that there is some plasticity in the brain, that some regions may replace the function of others.

A rough estimate suggests that there may be more than 100 trillion synapses in the brain, corresponding to about 1000 terabytes of storage capacity.

The Portuguese Neuroscientist António Egas Moniz (1874-1955) had an important role in uncovering the roles of different brain regions and how they interact. He was awarded the Nobel Prize in Physiology and Medicine in 1949.
Eating habits, exercise (both physical and intellectual), and regular sleep are important to maintain the brain active.

One of the most fascinating and interdisciplinary (and controversial) areas of brain research involves neuronal circuits, responsible for complex social behaviors.

Autism, Schizophrenia, Hyperactivity and other neuro-psychiatric disorders result from compromised connections between neurons.

Cutting-edge research in this field also includes the gut-brain axis, and how the fluctuations of infantile and helpful bacteria in the gut may influence brain activity via the vagus nerve.

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Quality control is essential for proper brain function. The formation and deposit of protein aggregates in neurons is correlated with cell death, and with conditioned motor problems.

Another important issue is the energy available for brain activity, produced by mitochondria, the “power plants” of cells.

Mitochondrial damage is also involved in neurodegeneration, and this problem can be worsened by conditions such as diabetes.

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But we must also remember that the enormous potential of this organ is present in each and every one of us. It should be unleashed daily to help us find the right solutions for a better future.

This also happens in neurodegenerative disorders such as Alzheimer’s, Parkinson’s, Huntington’s or Machado-Joseph disease. Where the main reason for communication breakdown is neuron death.

But everything that helps exercise this organ can be useful.

The brain also requires protein aggregates, boosting mitochondrial function, or controlling inflammation are some of the therapeutic strategies for brain disorders.

And such influence the progression of conditions such as Parkinson’s disease.

When a genetic component is involved, gene therapy may also be possible by reducing an altered gene, or reducing its activity.

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