Answering Your Questions About

Brain Research

Q: HOW DOES THE BRAIN WORK?

The brain is a multilayered web of cells: nerve cells (neurons) and vastly more numerous glial cells that stabilize the chemical environment and regulate and protect neurons.

The outermost layer, the cerebral cortex, is a fraction of an inch thick but contains 70 percent of all neurons. This most evolved part of the brain is divided into lobes specialized to regulate sensory experience, language and memory, and our sense of space. The frontal lobe is the most distinctively human region, responsible for judgment, planning and decision making.

Beneath the cortex are areas such as the basal ganglia, which controls movement; the limbic system, central to emotion; and the hippocampus, a keystone of memory.

The primitive brainstem regulates balance, coordination and life-sustaining processes such as breathing and heartbeat.

Throughout the brain, neurons communicate with one another through interlocking circuits. When a neuron is stimulated, it generates a tiny electrical current, which passes down a fiber, or axon. The end of the axon releases neurotransmitters —chemicals that cross a microscopic gap, or synapse — to stimulate other neurons nearby.

The process may be repeated thousands of times to create a circuit of electrical signals that produces movement, emotion, a sensory experience or thought.

Actually, a neuron typically communicates with many others simultaneously, and will or won't fire depending on the sum of signals it receives. Neuron-to-neuron activity extends widely, linking lobes and levels of the brain. Bundles of axons, "white matter," efficiently carry signals from region to region, like long-distance cables.

In recent years, this connectivity has become a focus of research as scientists explicate how the brain is wired and piece together the intricate orchestration of inner activity that ebbs and flows as we go about our lives — how reading, for example, integrates vision, language, emotion and reasoning centers.

At a projected cost of $4.5 billion, the BRAIN initiative is pushing this effort to its ultimate goal: Map the whole brain, neuron by neuron, and determine how these connections work in health and disease. The project is designed as a public-private endeavor, with initial funding from the federal government.

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