

Brain Facts

GLOSSARY

ACETYLCHOLINE A neurotransmitter active both in the brain, where it regulates memory, and in the peripheral nervous system, where it controls the actions of skeletal and smooth muscle.

ACTION POTENTIAL An electrical charge that travels along the axon to the neuron's terminal, where it triggers the release of a neurotransmitter. This occurs when a neuron is activated and temporarily reverses the electrical state of its interior membrane from negative to positive.

ADRENAL CORTEX An endocrine organ that secretes steroid hormones for metabolic functions; for example, in response to stress.

ADRENAL MEDULLA An endocrine organ that secretes epinephrine and norepinephrine in concert with the activation of the sympathetic nervous system; for example, in response to stress.

AGONIST 1.) A neurotransmitter, drug, or other molecule that stimulates receptors to produce a desired reaction. 2.) A muscle that moves a joint in an intended direction.

ALZHEIMER'S DISEASE A major cause of dementia in the elderly, this neurodegenerative disorder is characterized by the death of neurons in the hippocampus, cerebral cortex, and other brain regions.

AMINO ACID TRANSMITTERS The most prevalent neurotransmitters in the brain, these include glutamate and aspartate, which have excitatory actions on nerve cells, and glycine and gamma-aminobutyric acid (GABA), which have inhibitory actions on nerve cells.

AMYGDALA A structure in the forebrain that is an important component of the limbic system and plays a central role in emotional learning, particularly within the context of fear.

ANDROGENS Sex steroid hormones, including testosterone, found in higher levels in males than females. They are responsible for male sexual maturation.

ANTAGONIST 1.) A drug or other molecule that blocks receptors. Antagonists inhibit the effects of agonists. 2.) A muscle that moves a joint in opposition to an intended direction.

APHASIA Disturbance in language comprehension or production, often as a result of a stroke.

APOPTOSIS Programmed cell death induced by specialized biochemical pathways, often serving a specific purpose in the development of the animal.

AUDITORY NERVE A bundle of nerve fibers extending from the cochlea of the ear to the brain that contains two branches: the cochlear nerve, which transmits sound information, and the vestibular nerve, which relays information related to balance.

AUTONOMIC NERVOUS SYSTEM A part of the peripheral nervous system responsible for regulating the activity of internal organs. It includes the sympathetic and parasympathetic nervous systems.

AXON The fiberlike extension of a neuron by which it sends information to target cells.

BASAL GANGLIA Structures located deep in the brain that play an important role in the initiation of movements. These clusters of neurons include the caudate nucleus, putamen, globus pallidus, and substantia nigra. Cell death in the substantia nigra contributes to Parkinson's disease.

BRAINSTEM The major route by which the forebrain sends information to and receives information from the spinal cord and peripheral nerves. The brainstem controls, among other things, respiration and the regulation of heart rhythms.

BROCA'S AREA The brain region located in the frontal lobe of the left hemisphere that is important for the production of speech.

CATECHOLAMINES The neurotransmitters dopamine, epinephrine, and norepinephrine, which are active in both the brain and the peripheral sympathetic nervous system. These three molecules have certain structural similarities and are part of a larger class of neurotransmitters known as monoamines.

CEREBELLUM A large structure located at the roof of the hindbrain that helps control the coordination of movement by making connections to the pons, medulla, spinal cord, and thalamus. It also may be involved in aspects of motor learning.

CEREBRAL CORTEX The outermost layer of the cerebral hemispheres of the brain. It is largely responsible for all forms of conscious experience, including perception, emotion, thought, and planning.

CEREBRAL HEMISPHERES The two specialized halves of the brain. For example, in right-handed people, the left hemisphere is specialized for speech, writing, language, and calculation; the right hemisphere is specialized for spatial abilities, visual face recognition, and some aspects of music perception and production.

CEREBROSPINAL FLUID A liquid found within the ventricles of the brain and the central canal of the spinal cord.

CIRCADIAN RHYTHM A cycle of behavior or physiological change lasting approximately 24 hours.

CLASSICAL CONDITIONING Learning in which a stimulus that naturally produces a specific response (unconditioned stimulus) is repeatedly paired with a neutral stimulus (conditioned stimulus). As a result, the conditioned stimulus can come to evoke a response similar to that of the unconditioned stimulus.

COCHLEA A snail-shaped, fluid-filled organ of the inner ear responsible for converting sound into electrical potentials to produce an auditory sensation.

COGNITION The process or processes by which an organism gains knowledge or becomes aware of events or objects in its environment and uses that knowledge for comprehension and problem-solving.

CONE A primary receptor cell for vision located in the retina. It is sensitive to color and is used primarily for daytime vision.

CORPUS CALLOSUM The large bundle of nerve fibers linking the left and right cerebral hemispheres.

CORTISOL A hormone manufactured by the adrenal cortex. In humans, cortisol is secreted in the greatest quantities before dawn, readying the body for the activities of the coming day.

CRANIAL NERVE A nerve that carries sensory input and motor output for the head and neck region. There are 12 cranial nerves.

DEPRESSION A mental disorder characterized by sadness, hopelessness, pessimism, loss of interest in life, reduced emotional well-being, and abnormalities in sleep, appetite, and energy level.

DENDRITE A treelike extension of the neuron cell body. The dendrite is the primary site for receiving and integrating information from other neurons.

DOPAMINE A catecholamine neurotransmitter known to have varied functions depending on where it acts. Dopamine-containing neurons in the substantia nigra of the brainstem project to the caudate nucleus and are destroyed in Parkinson's victims. Dopamine is thought to regulate key emotional responses and plays a role in schizophrenia and drug abuse.

DORSAL HORN An area of the spinal cord where many nerve fibers from peripheral sensory receptors meet other ascending and descending nerve fibers.

DRUG ADDICTION Loss of control over drug intake or compulsive seeking and taking of drugs, despite adverse consequences.

ENDOCRINE ORGAN An organ that secretes a hormone directly into the bloodstream to regulate cellular activity of certain other organs.

ENDORPHINS Neurotransmitters produced in the brain that generate cellular and behavioral effects like those of morphine.

EPILEPSY A disorder characterized by repeated seizures, which are caused by abnormal excitation of large groups of neurons in various brain regions. Epilepsy can be treated with many types of anticonvulsant medications.

EPINEPHRINE A hormone, released by the adrenal medulla and specialized sites in the brain, that acts with norepinephrine to affect the sympathetic division of the autonomic nervous system. Sometimes called adrenaline.

ESTROGENS A group of sex hormones found more abundantly in females than males. They are responsible for female sexual maturation and other functions.

EVOKED POTENTIAL A measure of the brain's electrical activity in response to sensory stimuli. This is obtained by placing electrodes on the surface of the scalp (or more rarely, inside the head), repeatedly administering a stimulus, and then using a computer to average the results.

EXCITATION A change in the electrical state of a neuron that is associated with an enhanced probability of action potentials.

FOLLICLE-STIMULATING HORMONE A hormone released by the pituitary gland that stimulates the production of sperm in the male and growth of the follicle (which produces the egg) in the female.

FOREBRAIN The largest part of the brain, which includes the cerebral cortex and basal ganglia. The forebrain is credited with the highest intellectual functions.

FOVEA The centermost part of the eye located in the center of the retina and that contains only cone photoreceptors.

FRONTAL LOBE One of the four subdivisions of the cerebral cortex. The frontal lobe has a role in controlling movement and in the planning and coordinating of behavior.

GAMMA-AMINO BUTYRIC ACID (GABA) An amino acid transmitter in the brain whose primary function is to inhibit the firing of nerve cells.

GLIA Specialized cells that nourish and support neurons.

GLUTAMATE An amino acid neurotransmitter that acts to excite neurons. Glutamate stimulates N-methyl-d-aspartate (NMDA) and alpha-amino-3-hydroxy-5-methylisoxazole-4-propionic acid (AMPA). AMPA receptors have been implicated in activities ranging from learning and memory to development and specification of nerve contacts in developing animals. Stimulation of NMDA receptors may promote beneficial changes, whereas overstimulation may be a cause of nerve cell damage or death in neurological trauma and stroke.

GONAD Primary sex gland: testis in the male and ovary in the female.

GROWTH CONE A distinctive structure at the growing end of most axons. It is the site where new material is added to the axon.

HAIR CELLS Sensory receptors in the cochlea that convert mechanical vibration to an electrical signal; they in turn excite the 30,000 fibers of the auditory nerve that carry the signals to the brainstem.

HIPPOCAMPUS A seahorse-shaped structure located within the brain and considered an important part of the limbic system. One of the most studied areas of the brain, it functions in learning, memory, and emotion.

HOMEOSTASIS The normal equilibrium of body function.

HORMONES Chemical messengers secreted by endocrine glands to regulate the activity of target cells. They play a role in sexual development, calcium and bone metabolism, growth, and many other activities.

HUNTINGTON'S DISEASE A movement disorder caused by the death of neurons in the basal ganglia and other brain regions. It is characterized by abnormal movements called chorea — sudden, jerky movements without purpose.

HYPOTHALAMUS A complex brain structure composed of many nuclei with various functions, including regulating the activities of internal organs, monitoring information from the autonomic nervous system, controlling the pituitary gland, and regulating sleep and appetite.

INTERNEURON A neuron that exclusively signals another neuron.

INHIBITION A synaptic message that prevents a recipient neuron from firing.

IONS Electrically charged atoms or molecules.

LIMBIC SYSTEM A group of brain structures — including the amygdala, hippocampus, septum, basal ganglia, and others — that help regulate the expression of emotion and emotional memory.

LONG-TERM MEMORY The final phase of memory, in which information storage may last from hours to a lifetime.

MANIA A mental disorder characterized by excessive excitement, exalted feelings, elevated mood, psychomotor overactivity, and overproduction of ideas. It may be associated with psychosis; for example, delusions of grandeur.

MEMORY CONSOLIDATION The physical and psychological changes that take place as the brain organizes and restructures information to make it a permanent part of memory.

METABOLISM The sum of all physical and chemical changes that take place within an organism and all energy transformations that occur within living cells.

MIDBRAIN The most anterior segment of the brainstem. With the pons and medulla, the midbrain is involved in many functions, including regulation of heart rate, respiration, pain perception, and movement.

MITOCHONDRIA Small cylindrical organelles inside cells that provide energy for the cell by converting sugar and oxygen into special energy molecules, called adenosine triphosphate (ATP).

MONOAMINE OXIDASE (MAO) The brain and liver enzyme that normally breaks down the catecholamines norepinephrine, dopamine, and epinephrine, as well as other monoamines such as serotonin.

MOTOR NEURON A neuron that carries information from the central nervous system to muscle.

MYASTHENIA GRAVIS A disease in which acetylcholine receptors on muscle cells are destroyed so that muscles can no longer respond to the acetylcholine signal to contract. Symptoms include muscular weakness and progressively more common bouts of fatigue. The disease's cause is unknown but is more common in females than in males; it usually strikes between the ages of 20 and 50.

MYELIN Compact fatty material that surrounds and insulates the axons of some neurons.

NMDA RECEPTORS N-methyl-d-aspartate (NMDA) receptors, one of three major classes of glutamate receptors, which have been implicated in activities ranging from learning and memory to development and specification of nerve contacts in a developing animal.

NECROSIS Cell death due to external factors, such as lack of oxygen or physical damage, that disrupt the normal biochemical processes in the cell.

NERVE GROWTH FACTOR A substance whose role is to guide neuronal growth during embryonic development, especially in the peripheral nervous system. Nerve growth factor also probably helps sustain neurons in the adult.

NEURON A nerve cell specialized for the transmission of information and characterized by long, fibrous projections called axons and shorter, branchlike projections called dendrites.

NEUROPLASTICITY A general term used to describe the adaptive changes in the structure or function of nerve cells or groups of nerve cells in response to injuries to the nervous system or alterations in patterns of their use and disuse.

NEUROTRANSMITTER A chemical released by neurons at a synapse for the purpose of relaying information to other neurons via receptors.

NOCICEPTORS In animals, nerve endings that signal the sensation of pain. In humans, they are called pain receptors.

NOREPINEPHRINE A catecholamine neurotransmitter, produced both in the brain and in the peripheral nervous system. Norepinephrine is involved in arousal and in regulation of sleep, mood, and blood pressure.

OCCIPITAL LOBE One of the four subdivisions of the cerebral cortex. The occipital lobe plays a role in processing visual information.

OLFACTORY BULB A round, knoblike structure of the brain responsible for processing the sense of smell. Specialized olfactory receptor cells are located in a small patch of mucous membrane lining the roof of the nose. Axons of these sensory cells pass through perforations in the overlying bone and enter two elongated olfactory bulbs lying on top of the bone.

ORGANELLES Small structures within a cell that maintain the cell and do the cell's work.

PARASYMPATHETIC NERVOUS SYSTEM A branch of the autonomic nervous system concerned with the conservation of the body's energy and resources during relaxed states.

PARIETAL LOBE One of the four subdivisions of the cerebral cortex. The parietal lobe plays a role in sensory processes, attention, and language.

PARKINSON'S DISEASE A movement disorder caused by death of dopamine neurons in the substantia nigra, located in the midbrain. Symptoms include tremor, shuffling gait, and general reduction in movement.

PEPTIDES Chains of amino acids that can function as neurotransmitters or hormones.

PERIPHERAL NERVOUS SYSTEM A division of the nervous system consisting of all nerves that are not part of the brain or spinal cord.

PHOSPHORYLATION Transfer of a phosphate molecule from adenosine triphosphate (ATP) to a protein (ion channel, neurotransmitter receptor, or other regulatory protein), resulting in activation or inactivation of the protein. Phosphorylation is believed to be a necessary step in allowing some neurotransmitters to act and is often the result of second-messenger activity.

PHOTORECEPTOR A nerve ending, cell, or group of cells specialized to sense or receive light.

PITUITARY GLAND An endocrine organ closely linked with the hypothalamus. In humans, the pituitary gland is composed of two lobes and secretes several different hormones that regulate the activity of other endocrine organs throughout the body.

PONS A part of the hindbrain that, with other brain structures, controls respiration and regulates heart rhythms. The pons is a major route by which the forebrain sends information to and receives information from the spinal cord and peripheral nervous system.

PSYCHOSIS A severe symptom of mental disorders characterized by an inability to perceive reality. Psychosis can occur in many conditions, including schizophrenia, mania, depression, and drug-induced states.

RECEPTOR CELL A specialized sensory cell, designed to pick up and transmit sensory information.

RECEPTOR MOLECULE A specific protein on the surface of or inside a cell with a characteristic chemical and physical structure. Many neurotransmitters and hormones exert their effects by binding to receptors on cells.

RETINA A multilayered sensory tissue that lines the back of the eye and contains the receptor cells to detect light.

REUPTAKE A process by which released neurotransmitters are absorbed for later reuse.

ROD A sensory neuron located in the periphery of the retina. The rod is sensitive to light of low intensity and is specialized for night-time vision.

SCHIZOPHRENIA A chronic mental disorder characterized by psychosis (e.g., hallucinations and delusions), flattened emotions, and impaired cognitive function.

SECOND MESSENGERS Substances that trigger communications among different parts of a neuron. These chemicals play a role in the manufacture and release of neurotransmitters, intracellular movements, carbohydrate metabolism, and processes of growth and development. The messengers' direct effects on the genetic material of cells may lead to long-term alterations of behavior, such as memory and drug addiction.

SEROTONIN A monoamine neurotransmitter believed to play many roles, including but not limited to temperature regulation, sensory perception, and the onset of sleep. Neurons using serotonin as a transmitter are found in the brain and gut. Several antidepressant drugs are targeted to brain serotonin systems.

SHORT-TERM MEMORY A phase of memory in which a limited amount of information may be held for several seconds or minutes.

STEM CELL Unspecialized cells that renew themselves for long periods through cell division.

STIMULUS An environmental event capable of being detected by sensory receptors.

STROKE A block in the brain's blood supply. A stroke can be caused by the rupture of a blood vessel, a clot, or pressure on a blood vessel (as by a tumor). Without oxygen, neurons in the affected area die and the part of the body controlled by those cells cannot function. A stroke can result in loss of consciousness and death.

SYMPATHETIC NERVOUS SYSTEM A branch of the autonomic nervous system responsible for mobilizing the body's energy and resources during times of stress and arousal.

SYNAPSE A physical gap between two neurons that functions as the site of information transfer from one neuron to another.

TASTE BUD A sensory organ found on the tongue.

TEMPORAL LOBE One of the four major subdivisions of each hemisphere of the cerebral cortex. The temporal lobe functions in auditory perception, speech, and complex visual perceptions.

THALAMUS A structure consisting of two egg-shaped masses of nerve tissue, each about the size of a walnut, deep within the brain. The key relay station for sensory information flowing into the brain, the thalamus filters out information of particular importance from the mass of signals entering the brain.

VENTRICLES Comparatively large spaces filled with cerebrospinal fluid. Of the four ventricles, three are located in the forebrain and one in the brainstem. The lateral ventricles, the two largest, are symmetrically placed above the brainstem, one in each hemisphere.

WERNICKE'S AREA A brain region responsible for the comprehension of language and the production of meaningful speech.

WHITE MATTER The part of the brain that contains myelinated nerve fibers. The white matter is white because it is the color of myelin, the insulation covering the nerve fibers.