

A Glossary of Key Brain Science Terms

www.dana.org

THE
DANA
FOUNDATION

—————keep in touch





(Italicized terms are defined within this glossary.)



adrenal glands: Located on top of each kidney, these two glands are involved in the body's response to stress and help regulate growth, blood *glucose* levels, and the body's *metabolic* rate. They receive signals from the brain and secrete several different hormones in response, including *cortisol* and *adrenaline*.

adrenaline: Also called epinephrine, this *hormone* is secreted by the *adrenal glands* in response to stress and other challenges to the body. The release of adrenaline causes a number of changes throughout the body, including the *metabolism* of carbohydrates to supply the body's energy demands.

allele: One of the variant forms of a *gene* at a particular location on a chromosome. Differing alleles produce variation in inherited characteristics such as hair color or blood type. A *dominant* allele is one whose physiological function—such as making hair blonde—is manifest even when only a single copy is present (among the two copies of each gene that everyone inherits from their parents). A *recessive* allele is one that manifests only when two copies are present.

amino acid: A type of small organic molecule. Amino acids have a variety of biological roles, but are best known as the “building blocks” of proteins.

amino acid neurotransmitters: The most prevalent *neurotransmitters* in the brain, these include glutamate and aspartate, which have excitatory actions, and glycine and gamma-amino butyric acid (GABA), which have inhibitory actions.

amygdala: Part of the brain's *limbic system*, this primitive brain structure lies deep in the center of the brain and is involved in emotional reactions, such as anger, as well as emotionally charged *memories*. It also influences behavior such as feeding, sexual interest, and the immediate “fight or flight” stress reaction that helps ensure that the body's needs are met.

amyloid-beta (A β) protein: A naturally occurring protein in brain cells. Large, abnormal clumps of this protein form the *amyloid plaques* that are the hallmark of Alzheimer's disease. Smaller groupings (oligomers) of A β seem more toxic to brain cells and are now thought by many researchers to be important initiators of the Alzheimer's disease process.

amyloid plaque: The sticky, abnormal accumulations of *amyloid-beta protein* aggregate around neurons and synapses in the *memory* and intellectual centers of the brain, in people with Alzheimer's. These are sometimes referred to as neuritic plaques or senile plaques. While amyloid plaques have long been considered markers of Alzheimer's, they are also found to some extent in many cognitively normal elderly people. Plaques' role in Alzheimer's neurodegeneration remains unclear.

animal model: A laboratory animal that—through changes in its diet, exposure to toxins, genetic changes, or other experimental manipulations—mimics specific signs or symptoms of a human disease. Many of the most promising advances in treating brain disorders have come from research on animal models.

A (continued)

astrocyte: A star-shaped *glial* cell that delivers “fuel” to the *neurons* from the blood, removes waste from the *neuron*, and otherwise modulates the activity of the *neuron*. Astrocytes also play critical roles in brain development and the creation of *synapses*.

auditory cortex: Part of the brain’s *temporal lobe*, this region is responsible for hearing. Nerve fibers extending from the inner ear carry nerve impulses generated by sounds into the auditory cortex for interpretation.

autonomic nervous system: Part of the *central nervous system* that controls functions of internal organs (e.g., blood pressure, respiration, intestinal function, urinary bladder control, perspiration, body temperature). Its actions are mainly involuntary.

axon: A long, single nerve fiber that transmits messages, via electrochemical impulses, from the body of the *neuron* to dendrites of other *neurons*, or directly to body tissues such as muscles.

B

basal ganglia: A group of structures below the *cortex* involved in motor, *cognitive*, and emotional functions.

basilar artery: Located at the base of the skull, the basilar artery is one of the major vascular components supplying oxygenated blood to the brain and nervous system.

biomarkers: A measurable physiological indicator of a biological state or condition. For example, *amyloid plaques*—as detected on amyloid *PET* scans, for example—are a biomarker of Alzheimer’s disease. Biomarkers can be used for both diagnostic and therapeutic purposes.

brain-computer interface: A device or program that permits direct or indirect collaboration between the brain and a computer system. For example, a device that harnesses brain signals to control a screen cursor or prosthetic limb.

brain imaging: Refers to various techniques, such as *magnetic resonance imaging (MRI)*, *diffusion tensor imaging*, and *positron emission tomography (PET)*, that enable scientists to capture images of brain tissue and structure and to reveal what parts of the brain are associated with various behaviors or activities.

brain stem: A primitive part of the brain that connects the brain to the *spinal cord*. The brain stem controls functions basic to the survival in animal such as heart rate, breathing, digestive processes, and sleeping.



C



central nervous system: The brain and *spinal cord* constitute the central nervous system and are part of the broader nervous system, which also includes the *peripheral nervous system*.

central sulcus: The primary groove in the brain's *cerebrum*, which separates the *frontal lobe* in the front of the brain from the *parietal* and *occipital lobes* in the rear of the brain.

cerebellar artery: The major blood vessel providing oxygenated blood to the *cerebellum*.

cerebellum: A brain structure located at the top of the *brain stem* that coordinates the brain's instructions for skilled, repetitive movements and helps maintain balance and posture. Recent research also suggests the cerebellum may play a role, along with the *cerebrum*, in some emotional and *cognitive* processes.

cerebrum (also called cerebral cortex): The largest brain structure in humans, accounting for about two-thirds of the brain's mass and positioned over and around most other brain structures. The cerebrum is divided into left and right *hemispheres*, as well as specific areas called lobes that are associated with specialized functions.

chronic traumatic encephalopathy (CTE): Once known as dementia pugilistica and thought to be confined largely to former boxers, this progressive degenerative disease, with symptoms including impulsivity, *memory* problems, and *depression*, affects the brains of individuals who have suffered repeated concussions and *traumatic brain injuries*.

cognition: A general term that includes thinking, perceiving, recognizing, conceiving, judging, sensing, reasoning, and imagining. Also used as an adjective pertaining to cognition, as in "cognitive processes."

cognitive neuroscience: The field of study that investigates the biological mechanisms of *cognition*.

computational neuroscience: An interdisciplinary field of study that uses information processing properties and algorithms to further the study of brain function and behavior.

computed tomography (CT or CAT): An X-ray technique introduced in the early 1970s that enables scientists to take cross-sectional images of the body and brain. CT uses a series of X-ray beams passed through the body to collect information about tissue density, then applies sophisticated computer and mathematical formulas to create an anatomical image from the data.

connectome: A detailed map, or "wiring diagram," of the myriad neural connections that make up the brain and nervous system.



C

consciousness: The state of being aware of one's feelings and what is happening around one; the totality of one's thoughts, feelings, and impressions.

corpus callosum: The collection of nerve fibers connecting the two *cerebral hemispheres*.

cortex: The outer layer of the *cerebrum*. Sometimes referred to as the cerebral cortex.

cortisol: A steroid *hormone* produced by the *adrenal glands* that controls how the body uses fat, protein, carbohydrates, and minerals, and helps reduce inflammation. Cortisol is released in the body's stress response; scientists have found that prolonged exposure to cortisol has damaging effects on the brain.

CRISPR (clustered regularly-interspaced short palindromic repeats): A relatively precise and reliable *DNA* editing technique, which is derived from a primitive antiviral system found in bacteria. There is hope that CRISPR technology can be adapted to help treat brain disorders.

CT scan (also called CAT scan): See *computed tomography*.

D

deep brain stimulation: A method of treating various neuropsychiatric and *neurodegenerative* disorders through small, controlled electric shocks administered from a special battery-operated neurostimulation implant. The implant, sometimes called a brain pacemaker, is placed within deep brain regions such as the globus pallidus or subthalamus.

default-mode network: The network indicates that the brain remains active even if not involved in a specific task. So whether asleep or daydreaming, the brain is in an active state.

delayed discounting: A common *cognitive* task used to measure impulsivity in individuals. The task measures an individual's preference for the immediate delivery of a small reward versus a larger reward delivered later.

dementia: General mental deterioration from a previously normal state of *cognitive* function due to disease or psychological factors. Alzheimer's disease is one form of dementia.

dendrites: Short nerve fibers that project from a nerve cell, generally receiving messages from the *axons* of other *neurons* and relaying them to the cell's nucleus.

D

(continued)

depression: A mood or affective disorder characterized by sadness and lack of motivation. Depression has been linked to disruptions in one or more of the brain's *neurotransmitter* systems, including those related to *serotonin* and *dopamine*. Clinical depression is a serious condition that can often be effectively treated with medications and/or behavioral therapy.

Diagnostic and Statistical Manual of Mental Disorders (DSM): The standard classification manual published by the American Psychiatric Association to be used by mental health professionals to diagnose and treat mental disorders.

diffusion tensor imaging: A *brain imaging* method that helps visualize the brain's *white matter* tracts.

DNA (deoxyribonucleic acid): The material from which the 46 chromosomes in each cell's nucleus is formed. DNA contains the codes for the body's approximately 30,000 *genes*, governing all aspects of cell growth and inheritance. DNA has a *double-helix* structure—two intertwined strands resembling a spiraling ladder.

dominant gene: A *gene* that almost always results in a specific physical characteristic, for example a disease, even though the patient's *genome* possesses only one copy. With a dominant *gene*, the chance of passing on the *gene* (and therefore the trait or disease) to children is 50-50 in each pregnancy.

dopamine: A *neurotransmitter* involved in motivation, learning, pleasure, the control of body movement, and other brain functions. Some addictive drugs greatly increase brain levels of dopamine, leading to a euphoric "high." Virtually all addictive substances, from nicotine to alcohol to heroin and crack cocaine, affect the dopamine system in one way or another.

double helix: The structural arrangement of *DNA*, which looks something like an immensely long ladder twisted into a helix, or coil. The sides of the "ladder" are formed by a backbone of sugar and phosphate molecules, and the "rungs" consist of nucleotide bases joined weakly in the middle by hydrogen bonds.

E

electroconvulsive therapy (ECT): A therapeutic treatment for *depression* and other mental illnesses that sends small electric currents over the scalp to trigger a brief seizure. It is one of the fastest ways known to reverse the symptoms of severely depressed individuals.

endocrine system: A body system composed of several different glands and organs that secrete *hormones*.

endorphins: *Hormones* produced by the brain, in response to pain or stress, to blunt the sensation of pain. *Narcotic* drugs, such as morphine, imitate the actions of the body's natural endorphins.

E

(continued)

enzyme: A protein that facilitates a biochemical reaction. Organisms could not function if they had no enzymes.

epigenetics: A subset of genetics that focuses on phenotypic trait variations caused by specific environmental factors that influence where, when, and how a gene is expressed.

F

fissure: A groove or indentation observed in the brain. Another word for *sulcus*.

frontal lobe: The front of the brain's *cerebrum*, beneath the forehead. This area of the brain is associated with higher *cognitive* processes such as decision-making, reasoning, social *cognition*, and planning, as well as motor control.

frontal operculum: The part of the frontal lobe that sits over the *insula*.

functional magnetic resonance imaging (fMRI): A *brain imaging* technology, based on conventional *MRI*, that gathers information relating to short-term changes in oxygen uptake by *neurons*. It typically uses this information to depict the brain areas that become more active or less active—and presumably more or less involved—while a subject in the fMRI scanner performs a cognitive task.

G

gamma-aminobutyric acid (GABA): A *neurotransmitter* implicated in brain development, muscle control, and reduced stress response.

gene: The basic unit of inheritance. A gene is a distinct section of *DNA* in a cell's chromosome that encodes a specific working molecule—usually protein or *RNA*—with some role in brain or body function. Gene defects (genetic *mutations*) are thought to cause many disorders including brain disorders.

gene expression: The process by which a gene's nucleotide sequence is transcribed into the form of *RNA*—often as a prelude to being translated into a protein.

gene mapping: Determining the relative positions of *genes* on a chromosome and the distance between them.

genome: The complete genetic map for an organism. In humans, this includes about 30,000 *genes*, more than 15,000 of which relate to functions of the brain.

glia (or glial cells): The supporting cells of the *central nervous system*. Though probably not involved directly in the transmission of nerve signals, glial cells protect and nourish *neurons*.



G (continued)

glioma: A tumor that arises from the brain's *glial* tissue.

glucose: A natural sugar that is carried in the blood and is the principal source of energy for the cells of the brain and body. *PET* imaging techniques measure brain activity by detecting increases in the brain's *metabolism* of glucose during specific mental tasks.

gray matter: The parts of the brain and *spinal cord* made up primarily of groups of *neuron* cell bodies (as opposed to *white matter*, which is composed mainly of *myelinated* nerve fibers).

gyrus: The ridges on the brain's outer surface. Plural is gyri.

H

hemisphere: In brain science, refers to either half of the brain (left or right). The two hemispheres are separated by a deep groove, or fissure, down the center. Some major, specific brain functions are located in one or the other hemisphere.

hippocampus: A primitive brain structure, located deep in the brain, that is involved in *memory* and learning.

hormone: A chemical released by the body's *endocrine* glands (including the *adrenal glands*), as well as by some tissues. Hormones act on *receptors* in other parts of the body to influence body functions or behavior.

hypothalamus: A small structure located at the base of the brain, where signals from the brain and the body's *hormonal* system interact.

I

induced pluripotent stem cell (iPSC): A cell that has been taken from adult tissue and genetically modified to behave like an embryonic stem cell, with the ability to develop into any type of cell found in the body, including nerve cells.

insula: Sometimes referred to as the insular cortex, this small region of the *cerebrum* is found deep within the lateral *sulcus*, and is believed to be involved in *consciousness*, emotion, and body homeostasis.

interneuronal: Between *neurons*, as in interneuronal communication.





I (continued)

ions: Atoms or small groups of atoms that carry a net electric charge, either positive or negative. When a nerve impulse is fired, ions flow through channels in the membrane of a nerve cell, abruptly changing the voltage across the membrane in that part of the cell. This sets off a chain reaction of similar voltage changes along the cell's *axon* to the *synapse*, where it causes the release of *neurotransmitters* into the *synaptic cleft*.

L

lesion: An injury, area of disease, or surgical incision to body tissue. Much of what has been learned about the functions of various brain structures or pathways has resulted from lesion studies, in which scientists observe the behavior of persons who have suffered injury to a distinct area of the brain or analyze the behavior resulting from a lesion made in the brain of a laboratory animal.

limbic system: A group of evolutionarily older brain structures that encircle the top of the *brain stem*. The limbic structures play complex roles in emotions, instincts, and behavioral drives.

M

magnetic resonance imaging (MRI): A non-invasive imaging technology, often used for brain imaging. An MRI scanner includes intensely powerful magnets, typically 10,000 to 40,000 times as strong as the Earth's magnetic field. These magnets, combined with coils that send electromagnetic pulses into the scanned tissue, induce radio-frequency signals from individual hydrogen atoms within the tissue. The scanner records and processes these signals to build up an image of the scanned tissue. MRI scans are able to depict high resolution images of the entire brain, allowing clinicians to determine if the brain tissue that is visualized is normal, abnormal, or damaged due to a neurological disorder or trauma. MRI technology has also been adapted to measure brain activity *functional MRI*.

melatonin: A *hormone* that is secreted by the pineal gland in the brain in response to the daily light-dark cycle, influencing the body's sleep-wake cycle and possibly affecting sexual development.

memory: The encoding and storage of information, in a way that allows it to be retrieved later. In the brain, memory involves integrated systems of *neurons* in diverse brain areas, each of which handles individual memory-related tasks. Memory can be categorized into two distinct types, each with its own corresponding brain areas. Memory about people, places, and things—that one has experienced directly or otherwise learned about—is referred to as explicit or declarative memory and seems to be centered in the *hippocampus* and *temporal lobe*. Memory about motor skills and perceptual strategies is known as implicit, or procedural memory and seems to involve the *cerebellum*, the *amygdala*, and specific pathways related to the particular skill (e.g., riding a bicycle would involve the *motor cortex*).

metabolize: To break down or build up biochemical elements in the body, effecting a change in body tissue. Brain cells metabolize *glucose*, a blood sugar, to derive energy for transmitting nerve impulses.

M (continued)



microbiota: The community of various microorganisms found in the digestive tract. Scientists are now learning that microbes found in the microbiota can influence brain development and behavior.

microglia: A small, specialized *glial* cell that operates as the first line of immune defense in the central nervous system.

minimally conscious state: A disorder of *consciousness*, often caused by *stroke*, *head injury*, or loss of blood flow to the brain, in which an individual maintains partial conscious awareness.

molecular biology: The study of the structure and function of cells at the molecular level and how these molecules influence behavior and disease processes. Molecular biology emerged as a scientific discipline only in the 1970s, with advances in laboratory technologies for isolating and characterizing *DNA*, *RNA*, proteins, and other types of biological molecule.

motor cortex: The part of the brain's *cerebrum*, just to the front of the *central sulcus* in the *frontal lobe*, that is involved in movement and muscle coordination. Scientists have identified specific spots in the motor cortex that control movement in specific parts of the body, the so-called "motor map."

MRI: See *magnetic resonance imaging* and/or *functional magnetic resonance imaging*.

mutation: A permanent structural alteration to *DNA* that alters its previous nucleotide sequence. In most cases, *DNA* changes either have no effect or cause harm, but occasionally a mutation improves an organism's chance of surviving and procreating.

myelin: The fatty substance that sheathes most nerve cell *axons*, helping to insulate and protect the nerve fiber and effectively speeding up the transmission of nerve impulses.

N

narcotic: A synthetic chemical compound that mimics the action of the body's natural *endorphins*—*hormones* secreted to counteract pain. Narcotic drugs have a valid and useful role in the management of pain but may lead to physical *dependence* in susceptible individuals if used for long periods.

neuroeconomics: An interdisciplinary field of study that uses neuroscientific research to help explain human decision-making behavior.

neurodegenerative diseases: Diseases characterized by the progressive deterioration and death of nerve cells (neurodegeneration), typically originating in one area of the brain and spreading to other connected areas. Neurodegenerative diseases include amyotrophic lateral sclerosis (also known as Lou Gehrig's disease), Huntington's disease, Alzheimer's disease, frontotemporal degeneration, and Parkinson's disease.



neuroeducation: Sometimes referred to as educational neuroscience, this collaborative, interdisciplinary field of study uses findings in cognitive neuroscience to inform teaching and other educational practices.

neuroethics: An interdisciplinary field of study that addresses the ethical issues of our increased ability to understand and change the brain. Privacy, life extension, cloning, and many other issues are included in this ongoing social-scientific debate.

neurogenesis: The production of new, maturing *neurons* by neural *stem and* progenitor cells. Rapid and widespread neurogenesis obviously occurs in the fetal brain in humans and other animals. Neuroscientists long believed that neurogenesis essentially does not occur in the adult human brain. However, over the past two decades, research has shown that it does in fact occur in the dentate gyrus of the *hippocampus* and possibly other brain regions. This “adult neurogenesis” appears to be vital for normal learning and *memory*, and may help protect the brain against stress and *depression*. Neural *stem cells*, which can produce new, “young” *neurons* and *glial cells*, also may be used widely someday to treat brain disorders, particularly *neurodegenerative diseases* that otherwise deplete the neuronal population.

neuroimmunology: A complex field in biomedical research, which focuses on the brain, the immune system, and their interactions. Neuroimmunology holds the potential for conquering ills as diverse as *spinal cord* injury, multiple sclerosis, and bodily reactions to pathogens, both naturally occurring and intentionally inflicted.

neuron: Nerve cell. The basic unit of the *central nervous system*, the neuron is responsible for the transmission of nerve impulses. Unlike any other cell in the body, a neuron consists of a central cell body as well as several threadlike “arms” called *axons* and *dendrites*, which transmit nerve impulses. Scientists estimate that there are approximately 100 billion neurons in the brain.

neuroscience: The study of brains and nervous systems, including their structure, function, and disorders. Neuroscience as an organized discipline gained great prominence in the latter part of the last century.

neurotransmitter: A chemical that acts as a messenger between *neurons* and is released into the *synaptic cleft* when a nerve impulse reaches the end of an *axon*. Several dozen neurotransmitters have been identified in the brain so far, each with specific, often complex roles in brain function and human behavior.

nurture: A popular term for the influence of environmental factors on human development such as the experiences one is exposed to in early life. The term is often used in the context of “nature versus nurture,” which relates to the interplay of “nature” (genetic or inherited, predetermined influences) and environmental, or experiential, forces.

O

occipital lobe: A part of the brain's *cerebrum*, located at the rear of the brain, above the *cerebellum*. The occipital lobe is primarily concerned with vision and encompasses the *visual cortex*.

olfactory: Pertaining to the sense of smell. When stimulated by an odor, olfactory *receptor* cells in the nose send nerve impulses to the brain's olfactory bulbs, which in turn transmit the impulses to olfactory centers in the brain for interpretation.

opiate: A synthetic (e.g., Demerol, Fentanyl) or plant-derived (e.g., opium, heroin, morphine) compound that binds and activates *opioid receptors* on certain *neurons*. Opiates typically but not always have pain-relieving, anxiety-reducing, and even euphoria-inducing effects, and are generally considered addictive.

opioid: An artificially derived drug or chemical that acts on the nervous system in a similar manner to opiates, influencing the “pleasure pathways” of the *dopamine* system by locking on to specialized *opioid receptors* in certain *neurons*.

opioid receptors (e.g., mu, delta, kappa): A class of receptors found on *neurons* in the brain, *spinal cord*, and digestive tract. Opioid receptors are involved in numerous functions, including pain control, mood, digestion, and breathing.

optogenetics: An innovative neuroscientific technique that uses light to turn genetically modified *neurons* on and off at will, in live animals.

oxytocin: Sometimes referred to as the “cuddle chemical,” this *hormone* can work as a *neurotransmitter* in the brain and has been linked to social attachment and parental care.

P

pain receptors: Specialized nerve fibers in the skin and on the surfaces of internal organs, which detect painful stimuli and send signals to the brain.

parietal lobe: The area of the brain's *cerebrum* located just behind the *central sulcus*. It is concerned primarily with the reception and processing of sensory information from the body and is also involved in map interpretation and spatial orientation (recognizing one's position in space vis-a-vis other objects or places).

peripheral nervous system: The nervous system outside the brain and *spinal cord*.

persistent vegetative state: A disorder of *consciousness*, often following severe brain trauma, in which an individual has not even minimal conscious awareness. The condition can be transient, marking a stage in recovery, or permanent.



P (continued)



PET: See *positron emission tomography*.

pharmacotherapy: The use of pharmaceutical drugs for therapeutic purposes.

pituitary gland: An *endocrine* organ at the base of the brain that is closely linked with the *hypothalamus*. The pituitary gland is composed of two lobes and secretes a number of *hormones* that regulate the activity of the other *endocrine* organs in the body.

plasticity: In *neuroscience*, refers to the brain's capacity to change and adapt in response to developmental forces, learning processes, injury, or aging.

positron emission tomography (PET): An imaging technique, often used in *brain imaging*. For a PET scan of the brain, a radioactive “marker” that emits, or releases, positrons (parts of an atom that release gamma radiation) is injected into the bloodstream. Detectors outside of the head can sense these “*positron emissions*,” which are then reconstructed using sophisticated computer programs to create “tomographs,” or computer images. Since blood flow and metabolism increase in brain regions at work, those areas have higher concentrations of the marker, and researchers are able to see which brain regions are activated during certain tasks or exposure to sensory stimuli. Ligands can be added to a PET scan in order to detect pathological entities such as *amyloid* or *tau* deposits.

postsynaptic cell: The *neuron* on the receiving end of a nerve impulse transmitted from another *neuron*.

Post-traumatic stress disorder (PTSD): A mental disorder that develops in response to a traumatic event such as combat, sexual assault, terrorism, or abuse. Symptoms can include mood disturbances, hyperarousal, *memory* flashbacks, sleep problems, anxiety, and *depression*.

prefrontal cortex: The area of the *cerebrum* located in the forward part of the *frontal lobe*, which mediates many of the higher *cognitive* processes such as planning, reasoning, and “social cognition”—a complex skill involving the ability to assess social situations in light of previous experience and personal knowledge, and interact appropriately with others. The prefrontal cortex is thought to be the most recently evolved area of the brain.

premotor cortex: The area of the *cerebrum* located between the *prefrontal cortex* and the *motor cortex*, in the *frontal lobe*. It is involved in the planning and execution of movements.

presynaptic cell: In *synaptic transmission*, the *neuron* that sends a nerve impulse across the *synaptic cleft* to another *neuron*.

P

(continued)



prion: A protein aggregate that can propagate itself, inducing the formation of new aggregates from individual copies of the protein it encounters. Prions have the potential to spread within the body and brain, and even from one organism to another—“infectiously,” like a virus. The first prions described were hardy aggregates of PrP, the prion protein. They are responsible for a set of rapid, fatal and potentially transmissible *neurodegenerative diseases* including Creutzfeldt-Jakob disease and bovine spongiform encephalopathy (“mad cow disease”). Many researchers now argue that protein aggregates in other *neurodegenerative diseases*, such as the $A\beta$ and *tau* aggregates of Alzheimer’s, have such similar properties that they also deserve to be called prions. In some organisms, such as yeast, certain proteins apparently evolved to function normally in a prion-like form.

protein folding: The process by which the chain of *amino acids* that make up a protein assumes its functional shape. The protein aggregation that occurs in some *neurodegenerative* disorders is thought to be triggered when proteins “misfold.”

psychiatry: A medical specialty dealing with the diagnosis and treatment of mental disorders. (Contrast with *psychology*).

psychoactive drug: A broad term for any drug that acts on the brain and noticeably alters one’s mental state such as by elevating mood or alertness, or reducing inhibitions. Psychoactive pharmaceuticals can help control the symptoms of some neurological and *psychiatric* disorders. Many “recreational drugs” are also psychoactive drugs.

psychological dependence: In the science of addiction, refers to the mood- and motivation-related factors that sustain addiction (such as craving a cigarette after a meal), as opposed to the “physical dependence” that manifests when a person attempts to kick the habit (e.g., tremors, racing pulse). Brain scientists now understand that psychological factors are central to addictive disorders and are often the most difficult to treat. (Also see *dependence*.)

psychology: An academic or scientific field of study concerned with the behavior of humans and animals and related mental processes. (Contrast with *psychiatry*.)

R

receptors: Molecules on the surfaces of *neurons* whose structures precisely match those of chemical messengers (such as *neurotransmitters* or *hormones*) released during *synaptic transmission*. The chemicals attach themselves to the receptors, in lock-and-key fashion, to activate the receiving cell structure (usually a *dendrite* or cell body).

R (continued)



recessive: A genetic trait or disease that appears only in patients who have received two copies of a *mutant gene*, one from each parent.

resting state: The state of the brain when it is not consciously engaged in an explicit task. *Brain imaging* techniques such as *fMRI* can be used to measure the residual activity that occurs in this state. Scientists are currently using resting state data to help map the *connectome*, for example.

reward/reinforcement brain network: Also known as the mesolimbic circuit, this important network of brain regions is implicated in risk and reward processing, as well as learning. It primarily uses *dopamine* for signaling.

reuptake: A process by which released *neurotransmitters* are absorbed for subsequent re-use.

ribonucleic acid (RNA): A chemical similar to a single strand of *DNA*. The sugar is ribose, not deoxyribose, hence RNA. In RNA, the letter U, which stands for uracil, is substituted for T in the genetic code. RNA delivers *DNA*'s genetic message to the cytoplasm of a cell, where proteins are made.

S

senses: The physiological inputs that provide critical information for perception and behavior from the outside world. The five classic senses are: sight, hearing, taste, touch, and smell.

serotonin: A *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 in the gut. A number of antidepressant drugs are targeted to brain serotonin systems.

social neuroscience: The field of study investigating the biological systems underlying social processes and behavior.

sonogenetics: A novel investigative approach that turns genetically modified *neurons* on and off using ultrasonic waves.

sono-stimulation: The activation of neural networks using ultrasound.

spinal cord: The “other half” of the *central nervous system* (with the brain). The spinal cord is a cable that descends from the *brain stem* to the lower back. It consists of an inner core of *gray matter* surrounded by *white matter*.

S (continued)

stem cells: Undifferentiated cells that can grow into heart cells, kidney cells, or other cells of the body. Originally thought to be found only in embryos, stem cells in the brain have unexpectedly been discovered in adults. Researchers have shown on research animals that stem cells can be transplanted into various regions of the brain, where they develop into both *neurons* and *glia*.

subgenual cortex: The region of the *frontal lobes* below the genu of the *corpus callosum* implicated in mood states.

sulcus: The shallower grooves on the brain's *cerebrum* (deeper grooves are called *fissures*). Plural is sulci.

synapse: The junction where an *axon* approaches another *neuron* or its extension (a *dendrite*); the point at which nerve-to-nerve communication occurs. Nerve impulses traveling down the *axon* reach the synapse and release *neurotransmitters* into the synaptic cleft, the tiny gap between *neurons*.

synaptic transmission: The process of cell-to-cell communication in the *central nervous system*, whereby one *neuron* sends a chemical signal across the synaptic cleft to another *neuron*.

T

tau protein: A type of protein abundantly found in *neurons*. When this protein is not adequately cleared from the brain, it can form tangles that are a key pathology of several *neurodegenerative* disorders including frontotemporal degeneration, *CTE*, and Alzheimer's disease.

telomere: The protective cap found at the end of a chromosome. Research studies suggest that these caps may be shortened in *neurodegenerative* disorders.

temporal lobes: The parts of the *cerebrum* that are located on either side of the head, roughly beneath the temples in humans. These areas are involved in hearing, language, *memory* storage, and emotion.

thalamus: A brain structure located at the top of the *brain stem*, the thalamus acts as a two-way relay station, sorting, processing, and directing signals from the *spinal cord* and mid-brain structures to the *cerebrum*, and from the *cerebrum* down.

transcranial electrical stimulation (tDCS and tACS): A non-invasive procedure that applies electrical stimulation to the scalp to increase or decrease neural signaling. The two main types are direct current stimulation (tDCS) and alternating current stimulation (tACS). They are used for therapeutic purposes as well as to study cognitive processing.

T

(continued)

transcranial magnetic stimulation (TMS): A non-invasive procedure that uses magnetic fields, applied over the scalp, to stimulate changes in neural processing. It is used as a treatment for *depression* as well as a research method to investigate cognitive processes.

traumatic brain injury (TBI): An injury to the brain acquired when the head is violently shook, struck, or pierced by an object. Moderate to severe TBI causes permanent impairments in brain function. Symptoms of mild TBI may include headache, dizziness, attention problems, or issues with behavior and mood.

V

vagus nerve stimulation: A treatment for epilepsy that involves a small implant that electrically stimulates the vagus nerve, which runs from the brainstem to the abdomen.

vertebral arteries: The major arteries of the neck, which merge to form the *basilar artery*.

vestibular: Refers to the sense of balance. Many people with hearing loss also have some degree of balance difficulties, since the vestibular (or balance) system and the auditory (or hearing) systems are so closely related.

visual cortex: The area of the *cerebrum* that is specialized for vision. It lies primarily in the *occipital lobe* at the rear of the brain, and is connected to the eyes by the optic nerves.

W

white matter: Brain or *spinal cord* tissue consisting primarily of the *myelin*-covered *axons* that extend from nerve cell bodies in the *gray matter* of the *central nervous system*.



Sources from the original Glossary, published in 2006, are included here, in addition to new updated sources reflecting the continuing evolution of neuroscience research.

- The Human Connectome Project, www.humanconnectomeproject.org.
- The Mayo Clinic, www.mayoclinic.org.
- *Mind Over Matter Teacher's Guide, Introduction and Background*, National Institute of Drug Abuse (NIDA), teens.drugabuse.gov/teachers/mind-over-matter/teachers-guide.
- National Human Genome Research Institute (NIH), www.nhgri.nih.gov.
- National Institutes of Health, NIH.gov.
- Society for Neuroscience, BrainFacts.org.
- Marcus S, ed., *Neuroethics: Mapping the Field*. Dana Press; Washington, DC (2002).
- Clayman C, ed. *The Human Body: An Illustrated Guide to Its Structure, Function, and Disorders*. Dorling Kindersley; New York (1995).
- Posner MI, Raichle ME. *Images of Mind*. Scientific American Library; New York (1994).
- *Blazing a Genetic Trail*, Howard Hughes Medical Institute, www.hhmi.org (1991).
- *Webster's New World Dictionary, 3rd College Edition*. Simon & Schuster; New York (1991).
- *Stedman's Medical Dictionary, 24th Edition*. Williams & Wilkins; Baltimore (1982).

Scientific Advisor: Jordan Grafman, Ph.D.

Published 2016