
Successful Aging & Your Brain



Questions about how memory works?
Want to learn how to lead a brain healthy lifestyle?

THE DANA FOUNDATION

Mission Statement

The Dana Foundation is a private philanthropic organization committed to advancing brain research and to educating the public in a responsible manner about research's potential: (1) to develop a better understanding of the brain and its functions; (2) to speed the discovery of treatments for brain disorders; and (3) to combat the stigma of brain disorders through education.

Strategies

The Foundation, founded in 1950, works to achieve its goals through grants to institutions engaged in innovative neuroscience research and through public outreach efforts. Its grants fund research in neuroscience in connection to human health and disease.

The Foundation promotes dialogue between researchers and lay audiences; provides validated information about the latest advances in research through its free publications and websites; engages people worldwide through the Alliances and International Brain Awareness Week; and highlights critical information about the brain through its social media.

At the core of the Foundation's philosophy is a belief in the importance of scientific inquiry and the engagement of the public in championing brain research.

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How many times have you walked into a room and forgotten what you came for?

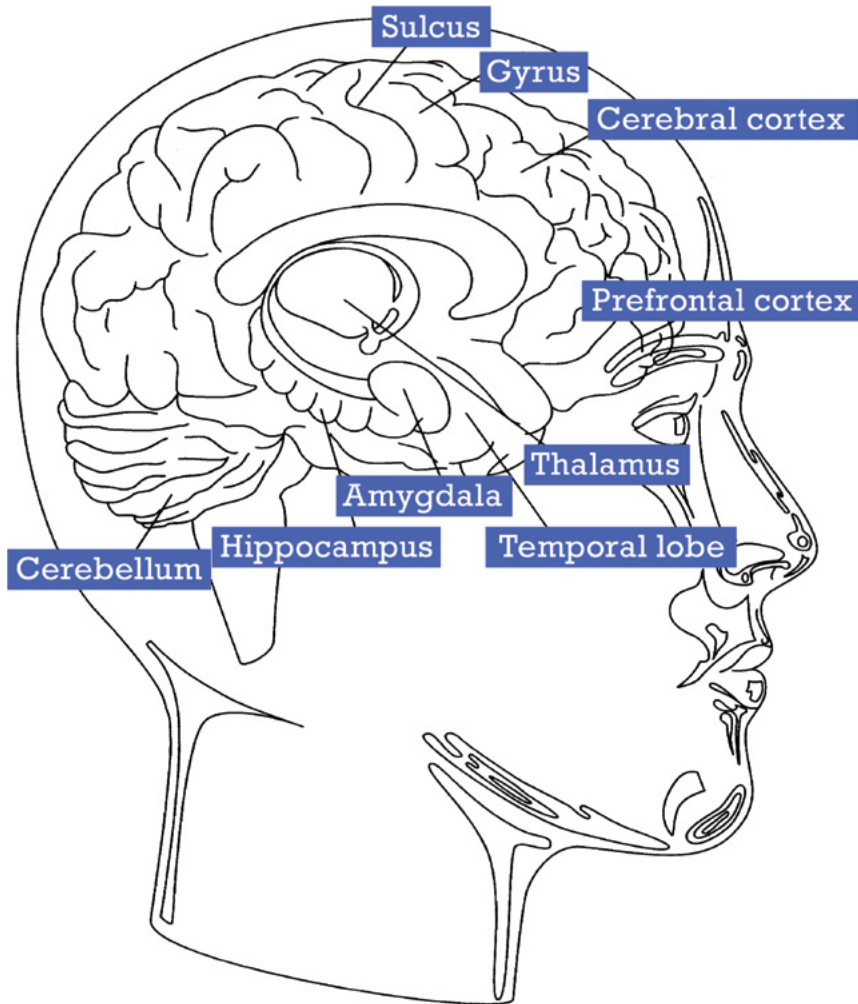
Searched for keys that have mysteriously disappeared?

Forgotten the name of someone you should know?

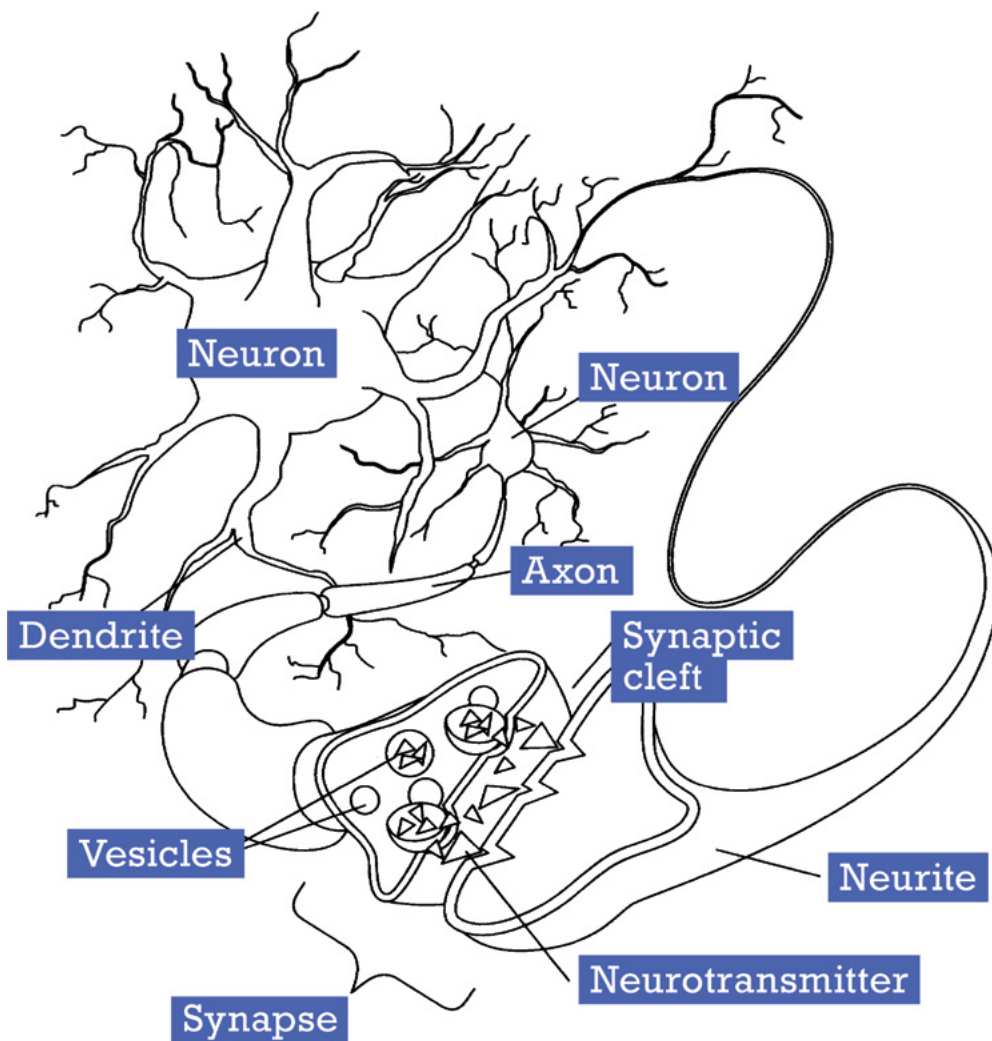
Moments of forgetfulness happen to everyone—even the young. But as we get older, forgetfulness may leave us wondering if we're losing our mental edge. The specter of Alzheimer's disease may even loom in our mind. Such feelings are natural—surveys suggest that cognitive dysfunction is among the most feared health problems—and it can be comforting to know the facts, understand the difference between “normal” changes and serious disease, and take steps to improve your brain health.

Scientists speak of brain aging in broad terms of cognitive changes in mental abilities including reasoning, attention, imagination, insight, executive functions such as planning and decision-making, and even appreciation of beauty. But for most of us, memory is the chief concern.

Getting to Know Your Brain



Every experience, whether it's solving a mathematical problem, hitting a ball with a club, or feeling the warmth of the sun, is represented in the brain as patterns of electrical and chemical signals traveling between nerve cells. Each thought, action, or sensory perception stimulates distinct sets of nerve cells and brain chemicals. One can imagine each cell as a musician in an elaborate symphony orchestra, playing its individual notes in harmony with other sections of the orchestra. The concerto that emerges is nothing less than human behavior.



Nerve cells, or neurons, are the workhorses of the brain. Their fibers, or axons, form connections called synapses with other neurons. When activated, a neuron sends low-level electrical currents down its axon, releasing brain chemicals (neurotransmitters) that diffuse across a microscopic gap and latch onto receptors on the receiving neuron. This sets off a cascade of chemical events that pass the signal along its axon, like a runner in a relay race.

When we perform or experience something repeatedly, such as practicing a musical score, we activate the same circuit of synapses over and over again. These repetitions enhance the efficiency of the circuit and encode the experience or behavior as a lasting memory.

How Memories Are Made

Memory is a series of interrelated processes including the registering of information, its encoding in neuron connections for storage, and its later retrieval or recall.

Scientists believe that the hippocampus, the amygdala, and neighboring structures form the core of the brain's memory acquisition system. They are connected by elaborate pathways of neural circuitry to the cerebral cortex, the irregular folds and ridges on the surface of the brain where long-term memories are stored.

The brain seems to have different, but overlapping, systems for the two primary types of memories, declarative and nondeclarative.

Declarative (also called explicit) memories can be recalled consciously and described verbally. They include the facts, people, places, and things that we encounter. Declarative memories primarily involve the brain's temporal lobes, especially the hippocampus, and the prefrontal cortex (PFC), where higher intellectual functions apparently originate. But aspects of a memory are also distributed to sensory areas. For example, we "remember" a face in the occipital lobe, which processes sight.

Nondeclarative (implicit) memory is the capacity for learning skills and procedures, including motor skills such as those used when playing golf or dancing. Nondeclarative memories engage brain structures outside the temporal lobes, including the amygdala and areas related to movement, such as the cerebellum and motor cortex.

"Learning is how you acquire new information about the world, and memory is how you store that information over time," says Eric R. Kandel, M.D., vice chairman of The Dana Alliance for Brain Initiatives and recipient of the 2000 Nobel Prize in Physiology or Medicine for his work on the molecular basis of memory. "There is no memory without learning, but there is learning without memory," Kandel says, because "you can learn things and forget them immediately."

In other words, not all learning turns into memories that last. We look up and retain a phone number just long enough to dial it. This so-called “working memory” still requires learning, but not for the long haul.

Scientific definitions aside, most of us understand “learning” to mean establishing memories that stick. Learning a new dance step, how to play a musical instrument, or the name of a new acquaintance all require that our brain encodes and stores information.

The cycle of learning, remembering, and forgetting continues throughout life.

But even well-encoded memories can fade: we learn and then forget. How much do you remember of what you learned in school? Algebraic formulas? Perhaps, if you’re a mathematician. Sentence diagramming? Maybe, if you’re a writer.

The point is, you may have learned these things—even aced the exams, perhaps—but unless you’ve used them in your day-to-day life, you may be hard-pressed to recall details. The cycle of learning, remembering, and forgetting continues throughout life.

In fact, when it comes to brain functions, forgetting may be almost as important as remembering: it would be inefficient for our brains to retain every bit of information we’re exposed to. How the brain sorts out what goes into long-term memory and what doesn’t is a matter of continuing debate, and it is influenced by many factors, including emotional state, stress level, environment, previous memories, biases, and perceptions.

Learning and Memory Change the Brain



As we go about our daily lives, the brain is in a state of continual activation, its various systems interconnecting to orchestrate how we respond to our environment in thought and behavior. The brain constantly adapts to new information we're feeding it: we change our brain each time we learn something.

"The adult brain, and even the adult aging brain, is fine-tuned by experience in both its performance and its abilities, essentially organizing itself in accord with its experience to prepare for the future," said the late William T. Greenough, Ph.D., a Dana Alliance member and neurobiologist at the University of Illinois at Urbana-Champaign. "Since one of the best predictors of future needs is past demands, having a brain that is optimally tuned to prior experience is ideal."

The brain's capacity to structurally change by learning is what scientists call its **plasticity**.

The Incredible Plastic Brain

Much of what we know about the brain processes that underlie learning comes from studies of laboratory animals in experimental situations. The following are among the brain changes that occur with learning:

Synaptic connections: When laboratory animals are raised in “enriched” environments with many more opportunities for new experiences, their neurons form more and larger synapses than those in animals reared in simple cages.

Capillaries: The tiny blood vessels that feed the brain increase when animals live in complex environments where they can exercise freely. Denser capillaries enhance the flow of blood and oxygen to brain tissue, which may have beneficial effects on neurons and neurochemicals.

Support cells: Animal research shows that glial cells, which nourish and support neurons, grow larger and more numerous in response to complex environments. These changes are believed to be vital for synaptic plasticity.

Myelination: Animal data suggest that learning increases myelin, the fatty sheath surrounding axons that enhances nerve signal transmission. Thickening seems particularly pronounced in the corpus callosum, the axon bundle that connects the brain’s left and right hemispheres.

Birth of new neurons: Scientists have found strong correlations between learning and neurogenesis (the generation of new neurons) in the hippocampus. When researchers increase neurogenesis experimentally, animals learn better. Reducing neurogenesis has an opposite effect.

Formation of new proteins: The transformation of newly acquired information into long-term memories throws a genetic switch that stimulates protein formation. Reexposure to the new information repeats the process, stabilizing encoding. If scientists block the switch experimentally, they can prevent long-term memories from being formed. A key component of this process appears to be long-term potentiation, an increase in synaptic connection strength.

How Do Learning and Memory Change with Age?

Neurobiologist and Dana Alliance member James L. McGaugh, Ph.D., of the University of California, Irvine, is a memory expert. He says that people often come to him with a look of desperation in their eyes, and say, “It’s happening to me: I can’t remember people’s names anymore.” What they don’t realize, McGaugh says, is that they did the same thing in their 20s—they just didn’t give it a second thought. “But now, they think about it all the time and get stressed and anxious about it, when in fact it could just be a normal slip of the mind.”

In truth, such “slips of the mind” happen all the time. Subtle deficits in memory of dates and events, for example, begin showing up at about the age of 20 and continue in a relatively linear fashion right into old age.

This gradual decline, say experts, simply parallels change in other body systems, from muscle coordination to lung capacity to cardiovascular strength. Why should the brain be any different?



What Types of Changes Are Common?

It's clear that not everyone—or every brain—ages in the same way. Memory studies have shown that about a third of healthy older people have difficulty with declarative memory. On the other hand, about one-fifth of 70-year-olds perform as well on cognitive tests as 20-year-olds. In general, short-term memory holds up well over the years. Our ability to recall past events and our memory for facts and concepts we use to solve problems also remain robust.

Among the more common memory changes with normal aging:

“I’m too old to learn anything new”: As we age, our ability to lay down new memories may be affected, making it harder to learn. It's not that we forget more easily, but that initial encoding takes longer. Still, if we take the time to commit the new information to memory—focus on it and fully learn it—then we will typically remember it as well as younger people.

“This is too complicated for me”: Multitasking taxes the brain at any age, and trying to do several things at once may become more difficult as we become slower to shift from one set of skills to another. Slowed processing may influence other aspects of cognition, such as planning and reasoning, and tasks that require “parallel processing,” such as holding multiple items in memory.

“What was that called again?”: Remembering names and numbers and recalling where and when you learned them are examples of “strategic” memory, which starts declining around age 20. We may have to intentionally engage our brain to learn information that we want to recall later. Literally telling yourself, “This is important, and I need to remember it,” repeating the information out loud, or making associations with things you already know can help.

“Wasn’t I supposed to be somewhere this afternoon?”: Without specific cues to jog our memory, we sometimes fail to recall such things as appointments made weeks earlier. Although the information was put into storage properly, we’re not accessing it when we need it. The best remedies are

visual reminders: write notes to yourself, track dates on a calendar, and post notices, invitations, or papers that need attention. (See “Minding Your Memory,” p. 16.)

How Aging Alters the Brain

Brain scientists believe that memory changes associated with normal aging, such as those discussed above, may result from a subtly changing environment within the brain—a puzzle that brain-imaging technology and advanced research techniques are helping scientists piece together. The hope is that understanding the neural basis of cognitive decline may lead to drug therapies and other strategies to slow or prevent it.

Some central findings are described below. These are generalizations: actual changes vary considerably from one person to another.

Brain mass: Beginning in about the sixth or seventh decade of life, brain mass shrinks steadily—particularly in such areas as the frontal lobe (important for higher cognitive functions) and the hippocampus (involved in encoding new memories).

Cortical density: The heavily ridged outer surface of the brain undergoes modest thinning. This does not, as scientists once believed, reflect widespread neuron loss (see “Brain Aging Myths You Can Forget,” p. 19), but is probably due to the steadily declining density of synaptic connections, which begins around age 20. Fewer thread-like fibers to send and receive nerve signals in the cortex may contribute to slower cognitive processing.

White matter: Many studies have linked aging with a decrease in white matter, the bundles of axons that carry nerve signals between brain cells. Their lengths seem to shorten, and myelin shrinks. Since myelin improves nerve transmission efficiency, its loss may slow processing. Scientists have correlated these changes with reduced cognitive function.

Neurotransmitter systems: The aging brain generates less chemical messengers and has fewer receptors to lock onto them. Decreased dopamine, acetylcholine, serotonin, and norepinephrine activity may

contribute to declining memory and cognition and to increased depression among older people.

Improving with Age

It's not all bad news. In many ways, the brain is like a fine wine, growing richer with each season. Skills we acquired earlier and have practiced over the years may be at their finest, whether they are mental, such as analyzing the stock market, or procedural, such as playing a musical instrument. As we age, we also develop a richer, more extensive vocabulary and contextual history in which to use words effectively.

Some recent research suggests that even the apparent slowdown in mental processing reflects, in part, the richer trove of information that the older brain must sort through.



Aging Wisely

“Wisdom” generally denotes enhanced capacity to grasp the essence of complex situations or problems and act accordingly. While usually associated with advancing age, wisdom may be more a matter of cumulative life experience: we’ve been exposed to more situations and have learned from decades of mistakes and successes. Wisdom means applying past lessons in judging present challenges and opportunities.

“We can make the brain work better simply by accumulating more knowledge, which builds more networks of connections,” says McGaugh. “The wisdom we acquire can compensate for the decline that may be gradually occurring.”

Only recently have researchers begun to study the neurobiology of wisdom. One clue comes from understanding the brain’s life cycle. According to neuroscientist and Dana Alliance member Jordan Grafman, Ph.D., director of Brain Injury Research at the Rehabilitation Institute of Chicago, the brain areas that develop first are the last to decline. Among these is the medial PFC, which helps regulate cognitive and motor processes. “The knowledge that we acquire early in life tends to be stored throughout life. As we age, we develop a history of life experiences, and we see the end of processes as well as the beginnings,” Grafman says. Access to this wealth of information affords us advantages in understanding situations and reacting appropriately.

Minding Your Memory

Based on what brain science tells us about how memory changes with age, some simple strategies can help us improve our ability to learn and remember things when we need to.

Relax: Tension makes memory lapses more likely. Reducing stress improves learning and recall.

Slow down, pay attention, and stay focused: If you want to recall something later, pay close attention to it now. Concentrate on what you're doing and reduce distractions and interruptions. Don't rush—focus and attention take time.

Repeat it: Repetition strengthens connections in your brain.

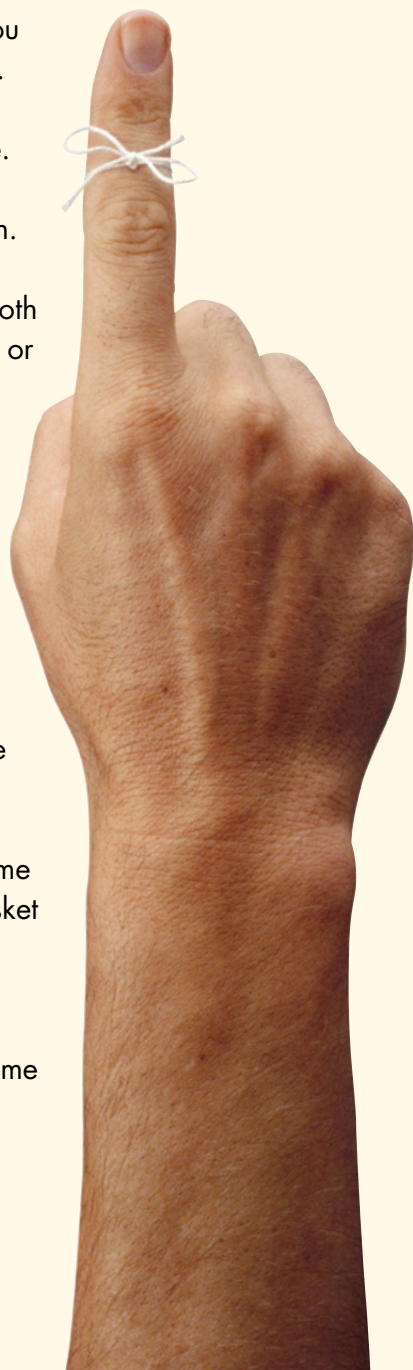
Write it down: Putting important information in writing both repeats it and provides a visual reminder. Carry a notepad or calendar, or use your smartphone.

Visualize: Creating an image of what you want to remember improves recall by giving your brain another way to access the information.

Make associations: Relate new experiences and information to what you already know, to embed it in existing synaptic connections. This strategy can be useful in remembering names: at a dinner party, you might associate "Pam" with "red dress" and "red wine."

Stay organized: Keep things you regularly use in the same place: put keys on a hook by the door, your wallet in a basket on your dresser.

Plan and prioritize: Because multitasking may be more difficult as we age, planning becomes critical. Prioritize: some things will simply have to wait.



When Is Memory Loss a Sign of Dementia?

Memory loss is one of the earliest symptoms of Alzheimer's and other types of dementia. Yet there are clear differences between what scientists call "normal age-related memory loss" (NARML) and dementia, in both symptoms and underlying brain changes. While dementia involves a broad loss of cognitive abilities, NARML is primarily a deficit of declarative memory (memory of facts and events). Anyone can forget where the car is parked, but forgetting that you took the car would be cause for concern.

Also important: not all dementia is due to Alzheimer's disease. Dementia is an umbrella term to describe conditions that impair intellectual and social functioning severely enough to interfere with daily activities. Alzheimer's disease is probably the most common form, but recent studies indicate that vascular dementia, a type caused by restricted blood flow to the brain, is also a growing problem. Some experts believe vascular dementia accounts for as much as one-third of all dementia, and "mixed dementia"—Alzheimer's plus vascular disease—another third. Alzheimer's and vascular dementia share a number of risk factors, including high blood pressure, diabetes, obesity, and high cholesterol, and controlling these factors through lifestyle and medical treatment could significantly reduce their incidence, experts say.

Where forgetfulness ends and dementia begins remains a subject of debate among brain aging experts. Neuroscience researchers are working to pin it down: one important clue is that people with Alzheimer's disease retain significantly less information after a period of delay than healthy people ("delayed recall"). That means that new information may be learned, but little will be remembered even a few hours later.

Other studies suggest that mild cognitive impairment (MCI), a condition marked by repeated lapses in short-term memory, represents early-stage Alzheimer's in some patients. Distinct changes in memory that occur over the course of a year or two and can be verified with psychological testing are hallmarks of MCI. Such changes are often too mild to significantly disrupt daily functions.

If you or someone you love is experiencing memory changes that interfere with work or home responsibilities, seek a doctor's help. Stress and fatigue can affect memory, and MCI may have causes other than Alzheimer's, such as side effects from medications, depression, stroke, or head injury.

For more information on Alzheimer's disease and other diseases of the aging brain, see the Dana Alliance's online booklet, *Late-Life Brain Disorders: Getting the Facts*:

http://www.dana.org/Staying_Sharp_LateLifeBrainDisorders.pdf

Successful Brain Aging

We all know people who stay sharp well into old age or blossom creatively in the second half of their lives. Feeling "old" is a state of mind, many say, and the cliché is truer now than ever, as modern medicine extends our life span and rewrites the rules of aging. Indeed, "normal aging" may be an outdated and misleading concept, as we come to understand how differently our brains age and how many factors influence the process.

Some of the body and mind changes normally associated with aging may not be normal at all, but are rather the result of treatable health conditions or a lifetime of poor health habits. What may seem like declining mental fitness in older people may actually be symptoms of an illness that should be medically evaluated and treated. For instance, the incidence of depression increases with age. Yet depression, a brain-based illness that can be successfully treated in most people, is often not recognized or properly treated. Many chronic health disorders, such as heart disease or high blood pressure, as well as many of the medications older people may need to take, can cause changes in mental functioning.

A word to the wise: Experts say that only about 30 percent of physical aging can be traced to our genes—the rest is up to us. There is a lot we can do to take charge of our brain health and maintain our cognitive fitness, no matter how old we are.

Brain-Aging Myths You Can Forget

You can't change your brain. Your brain constantly changes in response to your experiences, and it retains this fundamental "plasticity" well into old age. Everything we do and think about is reflected in patterns of activation in our brains. Scientists can see these patterns in brain-imaging scans that show which parts of the brain are functioning during specific tasks. Changing our thinking or changing the way we behave induces corresponding changes in the brain systems involved. This is why psychological therapies that teach people to alter negative patterns of thought and behavior can be effective in treating some mental disorders. Evidence from brain-imaging studies shows that the disrupted brain pathways actually change as a result of successful therapy.

We lose thousands of neurons every day. This persistent myth is based on early, flawed efforts to count the number of neurons in various brain regions. Scientists now know that the brain actually loses relatively few neurons with age. What loss there is tends to be concentrated in certain regions, such as the hippocampus and substantia nigra, which may explain some age-related decline in memory and physical agility.

The brain doesn't make new brain cells. This was the prevailing dogma for generations of neuroscientists, but research in the past few years has shot it down. It is now clear that certain areas of the brain, including the hippocampus and the olfactory bulb (the scent-processing center), regularly generate new neurons, many of which go on to become fully functioning players in brain circuits. This is a cutting-edge area of neuroscience, and new insights are emerging rapidly.

Memory decline is inevitable as we age. Plenty of people reach very old age and still are as sharp as ever. Genetics clearly plays a role in "successful aging," but how we live our daily lives is also critical—and something we can control. Physical and mental activity, diet, social connections, how we manage stress, and how we view our world and ourselves are all important factors.

Many of the scourges of aging might be prevented if we followed the old-fashioned advice of eating right, staying active, and getting plenty of rest. In fact, that same advice, along with a few new insights from aging research, can go a long way toward keeping not only our bodies healthy as we age, but our brains as well. Good mental health—“cognitive fitness”—is as important to overall quality of life as physical health. And it demands similar attention.

A positive outlook on life may be one of the most important things we can do to keep our brains healthy and ready to learn and to cope with the demands of life. How we view ourselves, how we perceive the world around us, and how we interact with others can have profound effects on our overall well-being and on our brain. These are things that are completely within our control. No matter what challenges we face, we can choose to start each day by looking at the glass as half full, rather than half empty.

There’s a lot to think positively about. A growing body of scientific research is focused on determining what’s different about people who age “successfully,” that is, with the least declines in cognition and memory. It appears they share certain characteristics that may contribute to keeping them mentally sharp.



Physical activity has benefits for people of any age, regardless of their current fitness levels. Many experts contend that regular exercise is the single most important thing we can do to improve overall health and prevent disease.

Exercise is strongly associated with successful brain aging. Exercise increases levels of brain chemicals that encourage the growth of neurons, which may be why aerobic activity (e.g., walking, biking, swimming) seems to sharpen memory and enhance learning. A recent study found that strength training also improves cognition in older women. There is increasing evidence that regular exercise reduces the risk of dementia and Parkinson's disease.

Studies in humans and animals have found that exercise has the following benefits:

- enhances memory and learning, as reflected by better performance on a range of cognitive tests
- improves mood and counteracts depression
- enlarges blood vessels so more blood and oxygen flow into the brain
- boosts levels of brain-derived neurotrophic factor (BDNF), a growth factor that supports and nourishes brain cells
- amplifies the rate at which new neurons are generated in the hippocampus
- increases the number of glia, brain cells that support neurons and speed neural processing.

Everyone can enjoy physical activity at little or no cost. It does not require a health club membership, fancy machines, or spandex clothing. All it takes is a little initiative.

Even moderate activity can have significant benefits. Recent studies from the Centers for Disease Control and Prevention show that about 30 minutes of exercise a day—even in 10-minute bouts—on most days of the week can provide many of the same health benefits as far more strenuous activity. Such daily tasks as gardening, walking the dog, and household chores count as moderate physical activity, so there's little excuse not to reap the rewards.

But for optimal brain and body benefits, the National Institute on Aging suggests a well-rounded fitness program that incorporates four types of exercise:

- Endurance exercises, such as walking and other aerobic activities, increase stamina and appear to delay and help prevent diabetes, heart disease, colon cancer, and stroke. Research strongly suggests that this kind of exercise reduces the risk of dementia and Parkinson's disease. Studies showing improved mood and relief from depression due to exercise have generally involved endurance exercises, particularly walking.
- Strength exercises, done with free weights or resistance weights, help keep body weight down and regulate blood sugar by building lean tissue to increase metabolism. They may also help prevent osteoporosis. In recent years, experts have increasingly emphasized the importance of strength exercises in the prevention and treatment of diabetes—a major threat to brain health.
- Flexibility exercises, such as stretching or yoga, help forestall injuries and promote quicker recovery from injuries, so you can stay active, mentally and physically.
- Balance exercises, including yoga, tai chi, and such simple practices as standing on one foot, help prevent falls—a significant cause of head injury, particularly in older people.

If it has been a long time since you have exercised, start slowly and build up gradually. You don't need to be a marathon runner; a 10-minute walk around your neighborhood is a great way to start. Before you begin any new physical activity or exercise program, speak with your doctor about what is right for you. Especially if you have heart disease or other chronic health conditions,

medical advice will be invaluable in helping you get the most from exercise, safely and with confidence.

Mental exercise, especially learning new things or pursuing activities that are intellectually stimulating, has been shown to strengthen brain cell networks and help preserve mental functions.

Longer formal education, even if completed years earlier, is associated with mental sharpness among older people. Scientists theorize that learning creates a “cognitive reserve” of denser, stronger nerve-cell connections that increases the brain’s ability to compensate for age-related changes in neural structure and function. It may also be that better-educated people tend to adopt more brain-healthy lifestyles, paying more attention to nutrition, for example.

You’re never too old to build your brain by using it. The brain’s remarkably undiminished capacity to alter and reorganize itself in response to learning and experience affords a tremendous opportunity to pursue a lifestyle that maximizes “brain power” and keeps the engine of learning revved up as we age. Experts are convinced that engaging in learning activities throughout life will help maintain brain health.



Put simply, the brain *wants* to learn; to be engaged and active as a learning machine. That means stepping out of old habits. When we settle into daily routines that we repeat all but automatically, the brain is largely operating on auto-pilot, and its level of activity dwindles. By trying something fresh and different—even approaching the day’s tasks and chores in novel ways—you can activate parts of the brain that have been falling into disuse. Some studies suggest that doing so may stimulate growth factors that support neurons and increase neurotransmitter production, among other beneficial effects on neural processes.

Think about the route you take to work or a familiar destination each day, which you do virtually without thinking. Taking a new route forces your brain to focus attention on what you’re doing, engaging it fully in the act of what had been a mindless task. Tricks like finding your keys or picking out coins in a purse by using your sense of touch rather than sight, or brushing your teeth with your nondominant hand can have the same effect.

Step out of character and do something you haven’t done before: take up a hobby, learn a new craft or foreign language, or join a club or group to meet new friends. Read books that make you think, or listen to unfamiliar music. There are a million ways to challenge and engage your brain. Find the ones that work for you.

Social connection: As we age, the more contact we have with others—staying socially active and connecting regularly with family and friends—the better we may become at preserving mental sharpness. Some evidence suggests that people who engage in more social activities are less likely to develop dementia.

How interpersonal relationships benefit the brain is not well understood: one theory is that a strong social network facilitates new learning and helps manage stress. “Frequent social activity—face-to-face or even online—is a memory-enhancing form of brain exercise,” suggests Patrick A. Griffith, Dana Alliance member and professor of clinical medicine at SABA University. “It stimulates both the registration of new memories and the recall of older ones, especially when emotionally charged or culturally significant issues are discussed.”



The data supporting the benefits of social connection are compelling. A major public health study involving more than 116,000 people found that those with strong relationships had less cognitive decline and lived more active, pain-free lives without physical limitations.

Conversely, social isolation is associated with faster decline and other health problems. In one study, people with the most limited social connections were twice as likely to die in a given period as those with the widest social networks.

Many experts believe that social isolation can create a chronically stressful condition that accelerates aging. This may pose a particular risk for older people, who are more likely to lead solitary lives, especially if family and friends have moved away or died.

Combating loneliness requires effort, both in establishing new relationships and in deepening existing ones. Here are some suggestions:

- Maintain a network of friends and family members whom you see or speak to regularly, and participate in organizations that get you out and among others.
- Get involved in religious, community, and other projects.
- Investigate the options available in your community, and take advantage of programs and services offered at community centers, local offices for aging, and senior centers.
- Seek out people who share your interests through involvement with religious centers, clubs, hospital foundations, and nonprofit organizations.
- Volunteer for groups that help others.
- Get connected while you improve your health in other ways: join a walking club, have a healthy dinner at a church social, or take an adult-education course in something that interests you.
- Don't overlook animal companionship: furry or feathered friends can bring great joy and purpose to our lives.

Self-efficacy, feeling good about ourselves and believing that what we do makes a difference, seems to prevent cognitive decline, according to several large studies that have chronicled lifestyle factors of people who stay mentally sharp into old age. The reasons are not entirely clear, but some experts believe it may be related to a greater resilience to stress.

Marilyn Albert, Ph.D., a Dana Alliance member and neuroscientist at Johns Hopkins University who led one of the first and most important of these studies, defines self-efficacy as an ability to adapt to life's challenges, to maintain a degree of control over our lives, and to feel that we are contributing to our families and society.

Evidence suggests that a sense of purpose preserves mental edge and even reduces the risk of dementia. A recent study of nearly one thousand older people found those leading a more “purpose-driven” life retained their cognitive capacities significantly better over the next seven years and were far less likely than their peers to develop Alzheimer’s disease.

To reap the benefits of self-efficacy, social connection, and a sense of purpose, volunteer for a cause in which you believe. The positive feelings that come from volunteering, what some call “the helper’s high,” have been shown to measurably lift mood, reduce depression symptoms, and lower blood pressure.

Manage stress: While acute, short-term stress can focus attention and improve memory, chronic stress takes a physical toll on the brain and body—particularly for those ages 60 and over. Stress has been linked to anxiety and depression. Some research suggests it impairs memory and makes the hippocampus—a key structure in memory formation—vulnerable to injury.

Stress reduction is among the many benefits of exercise and positive social interactions.

Stress undermines immune protection against infection and increases inflammation, leaving us vulnerable to diseases such as atherosclerosis, high blood pressure, and diabetes, which can seriously damage the brain.

Simply being busy isn’t stressful (especially if you enjoy what you’re doing). Being busy and feeling overwhelmed is. Learning to manage stress can go a long way toward improving your outlook on life and your health. While it is unrealistic to expect to eliminate stress entirely from our lives, we can and should learn coping strategies.

Stress reduction is among the many benefits of exercise and positive social interactions. Such techniques as biofeedback (which teaches you to control your body’s stress reactions, such as muscle tension and pounding pulse), medita-

tion, and relaxation or visual imagery therapies can also help. Distinguishing between what we can and can't control, and prioritizing activities to spend time on things that really matter to us and bring us pleasure, are important steps toward controlling stress.

Reduce vascular and diabetes risk: A healthy brain needs a healthy body. In particular, the brain's vitality depends on a robust circulatory system, and there is abundant evidence that cardiovascular risk factors—high blood pressure, high cholesterol, smoking, obesity, and diabetes—also increase the risk of cognitive decline. In fact, the effects of poor vascular health can be devastating: brain damage caused by impaired circulation—gradual and acute—is responsible for or contributes to up to two-thirds of dementia.

Diabetes, which significantly increases the risk of cardiovascular disease, has also been shown to impair brain function and hasten cognitive decline. Although the reasons are unclear—an inability to metabolize glucose properly or poorly controlled insulin levels may be involved—a recent review of multiple studies found that diabetes raises the risk of Alzheimer's and other dementias by 50 percent. Make a diabetes test, such as a fasting blood sugar level, a part of your regular physical exam.

Most of the things that promote brain health, such as social connection and stress control, also reduce cardiovascular risk. Exercise, in particular, is essential for strengthening circulation and preventing diabetes. If necessary, take prescribed medication for elevated blood pressure and cholesterol.

A key component of vascular and brain health is diet. Healthy eating doesn't have to be complicated. The Food Guide Pyramid from the U.S. Department of Agriculture, which emphasizes whole grains and fresh fruits and vegetables as the foundation for a well-balanced diet, is a good starting point.

Other suggestions:

- Drink 8–10 cups of fluid daily, and make at least 5 of them water. Limit caffeinated and alcoholic beverages.
- Replace saturated fat (such as that in animal products) with unsaturated fat (such as olive, canola, sunflower, safflower, and soybean oils), and eliminate trans fatty acids, found in many processed foods and listed among ingredients as hydrogenated vegetable oils. Include foods

containing omega-3 fatty acids, such as cold-water fish, in your diet. These fats appear to contribute to brain health, possibly by maintaining neuron membranes.

- Reduce salt intake, which has been linked to high blood pressure, to 1,500 milligrams daily, as recommended by government health guidelines. (The average American consumes more than twice that much.) Most of the salt we consume comes from processed and restaurant foods—including many “health foods,” such as vegetarian meat substitutes. Read labels carefully; when you eat out, ask to have your meal prepared with less salt. And of course, avoid the salt shaker at mealtime.
- When snacking, replace sugary treats with such healthy choices as fruit, vegetables, or whole-grain products.
- Make berries and citrus fruits part of your diet: they are high in antioxidants, which appear to protect the brain and cardiovascular system against the effects of aging.
- Join a cooking class to learn healthy meal-preparation techniques.
- Ask for help if you have difficulty preparing meals, or arrange for home-delivered meals from community programs. Many senior centers or religious centers also provide meals.



An estimated two-thirds of Americans are overweight and half of these are obese—a virtual epidemic that increases the risk of cardiovascular disease, stroke, and diabetes. Although exercise also plays a role, diet is the key to weight control. The recommendations listed above should help. But losing weight and keeping it off isn't easy for most people; if necessary, seek help from a nutritionist or dietitian. It's a wise investment in brain health.

Though we may need somewhat fewer calories as we age, we need just as many essential nutrients—more in some cases. For example, vitamin D is vital to maintain bone strength, and a number of studies have suggested its importance for brain health as well: low blood levels of vitamin D appear linked to an increased risk of dementia. The body can manufacture vitamin D from sun exposure, but this process markedly slows down with age, so it is essential to consciously choose foods that are good sources of vitamin D, such as egg yolks, fortified dairy and soy products, and liver.

Vitamin D supplements may be recommended for some people. But in general, food sources—not vitamin supplements—are the best way to get the nutrients you need. In fact, some vitamin and mineral supplements, as well as many herbal preparations, can interfere with the actions of prescription medicines. Herbal supplements in particular are poorly regulated, and many have not been properly studied to determine their effectiveness or possible side effects. Make sure to discuss with your doctor any supplements you are taking.

Sleep well: Research shows that adequate sleep is necessary to consolidate certain types of memories: if we don't sleep well, we don't learn as well. Brain function generally suffers. For older people in particular, poor sleep also increases stress and raises the risk of depression. Some studies have linked poor sleep to diabetes and high blood pressure.

As we age, according to the National Institute of Neurological Disorders and Stroke, we generally need about as much sleep as we did in early adulthood—seven to eight hours for most of us. It gets harder, however: people ages 65 and over tend to sleep less deeply, and more than half report sleep problems. But disrupted sleep and feeling tired during the day should not be accepted and endured as normal parts of aging.

There are more than 70 different sleep disorders, and most can be managed effectively once they are recognized and accurately diagnosed. The occurrence

of the most common ones, insomnia, sleep apnea, and restless legs syndrome, increases with age.

Sleep difficulties can be due to treatable medical or psychiatric disorders. The need to urinate frequently interrupts sleep, particularly in older men. Pain, such as leg cramps, back pain, and neck pain, is another common culprit. Waking too early and not getting back to sleep may be a symptom of depression. Troubled sleep is a frequent side effect of medication.

For all these reasons, it is important to discuss persistent changes in sleep patterns or difficulty sleeping with your doctor.

Improve your nights on your own by following basic rules of sleep hygiene:

- Exercise regularly, but not within a few hours of bedtime.
- Don't eat heavy meals late in the day.
- Practice relaxation techniques at bedtime, such as deep breathing, visualization, or meditation.
- Avoid caffeine, nicotine, and alcohol in afternoon and evening hours.
- Set regular bedtime and waking hours.
- If you do not fall asleep within 20 minutes of going to bed, get up and do something else until you feel tired.
- Keep the temperature in your bedroom steady (not too warm).
- Avoid reading, conversation, or television in bed.
- If you snore, avoid sleeping on your back, and elevate your head.
- Get treatment for allergies, colds, or sinus problems.
- Wake up to the sun, or use bright lights in the morning to keep your biological clock in synch.
- Do not lie in bed once awake in the morning.

Checklist for a Brain-Healthy Lifestyle

DO:

Exercise your body regularly, and get involved in physically engaging leisure activities.

Keep your mind exercised. Engage in active learning throughout life, and pursue new experiences.

Stay socially engaged with friends, family, and community groups.

Maintain a positive attitude and a sense of control over your life.

Take steps to manage stress.

Eat a brain-healthy, balanced diet rich in antioxidants and omega-3 fatty acids.

Mind your numbers: lose any extra pounds, lower your cholesterol if it is high, and keep your blood glucose and blood pressure under control.

Get adequate sleep.

Get proper medical attention and treatment for any underlying health problems.

DON'T:

Drink to excess, smoke, or use illicit drugs.

Ignore sudden changes in mental status (but don't be overly concerned about such normal slips of memory as forgetting names or where you put the keys).

Put off going to the doctor if you notice changes in your physical or mental health.

Overlook the possibility of drug interactions that can affect mental functioning, especially if you are taking more than one prescription medication.

Become isolated in your home.

Think you're too old to take up something new.

Conclusion

Brain science is making tremendous progress in illuminating what happens to memory and other cognitive functions throughout the life span. While many questions remain, it is clear that normal age-related memory loss is distinct from Alzheimer's and other dementias. There are a number of things we can do to preserve our mental abilities for a higher quality of life as we age. They may even help prevent cognitive impairment and dementia. By putting the good news from neuroscience into practice in our daily lives, we can all benefit from an ever-growing wealth of knowledge and improve our brain health as we age.

Neuroscience is an exciting, rapidly changing field. For up-to-date information on the brain and reports on the latest research, visit the website of the Dana Foundation, www.dana.org.

Resources

Alliance for Aging Research

1700 K Street, NW, Suite 740
Washington, DC 20006
202-293-2856
202-955-8394
www.agingresearch.org
Email: info@agingresearch.org

Alzheimer's Association

225 N. Michigan Avenue, Floor 17
Chicago, IL 60601
1-800-272-3900
www.alz.org
Email: info@alz.org

Alzheimer's Disease Education and Referral Center: National Institute on Aging

ADEAR Center
P.O. Box 8250
Silver Spring, MD 20907
1-800-438-4380
www.nia.nih.gov/alzheimers
Email: adear@nia.nih.gov

The Dana Foundation and The Dana Alliance for Brain Initiatives

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Fax: 212-317-8721
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Email: danainfo@dana.org and dabiinfo@dana.org

National Council on Aging

1901 L Street NW, Fourth Floor
Washington, DC 20036
202-479-1200
www.ncoa.org
Email: info@ncoa.org

National Institute on Aging

Building 31, Room 5C27
31 Center Drive, MSC 2292
Bethesda, MD 20892
1-800-222-2225
www.nih.gov/nia

National Institute of Neurological Disorders and Stroke: NIH Neurological Institute

P.O. Box 5801
Bethesda, MD 20824
1-800-352-9424
www.ninds.nih.gov

National Sleep Foundation

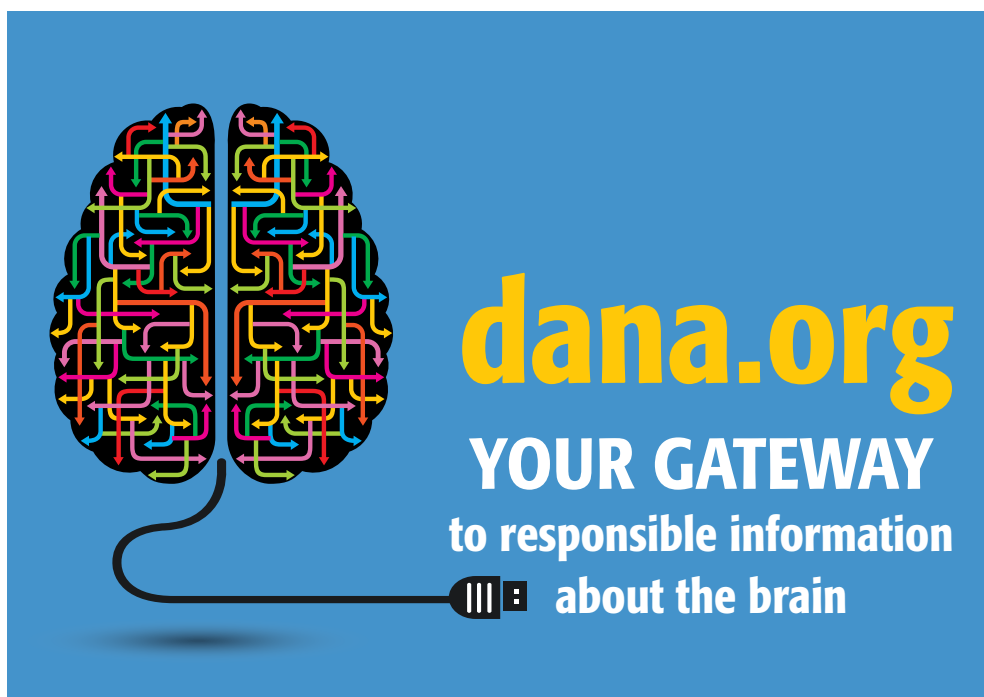
1010 N. Glebe Road, Suite 310
Arlington, VA 22201
703-243-1697
www.sleepfoundation.org
Email: nsf@sleepfoundation.org

United States Department of Agriculture

1400 Independence Avenue SW
Washington, DC 20250
202-720-2791
www.usda.gov
Email: webmaster@usda.gov

Ten Ways You Can Become a Brain Advocate

- **Stay informed on the brain.** Read articles and books and watch science programs that discuss new advances in brain research.
- **Participate in Brain Awareness Week.** Search for an event in your area, or find out how to get involved as a partner in the campaign at www.dana.org/BAW.
- **Spread the word.** Let your friends, neighbors, and co-workers know how important you think brain research is to you and your community. If you are a parent, encourage your children's schools to incorporate the brain into the classroom. Find resources at www.dana.org/kids.
- **Use social media.** Connect with the Dana Foundation and other like-minded organizations and share brain research updates with your friends and family on social media platforms.
- **Contact your representatives** to share information on important advances in brain research with them. Don't assume that they are up to date in their knowledge. If you think an article or piece of information about the brain is interesting, it is likely they will, too. Find your representatives at www.house.gov.
- **Donate your time and support** to the organizations or advocacy groups of your choice.
- **Support local colleges** and universities that have active teaching and research programs in neuroscience.
- **Alert the media.** Write to newspapers and broadcasters to let them know that you appreciate their coverage of the brain. Or, contact local media outlets to encourage increased coverage on the brain. Letters to the editor and opinion pieces are very effective ways of sharing your views. Tips for reaching out to the media can be found on the Brain Awareness Week website, www.dana.org/BAW.
- Participate in a clinical trial. Scientists learn from studies about how normal brains function. Search the National Institutes of Health's listing of trials at www.clinicaltrials.gov.
- **Be a role model** by living a brain-healthy life. Learn more at www.dana.org/Publications/SuccessfulAging.



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The **Dana Foundation** is a private philanthropic organization that supports brain research through grants, publications, and educational programs.

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