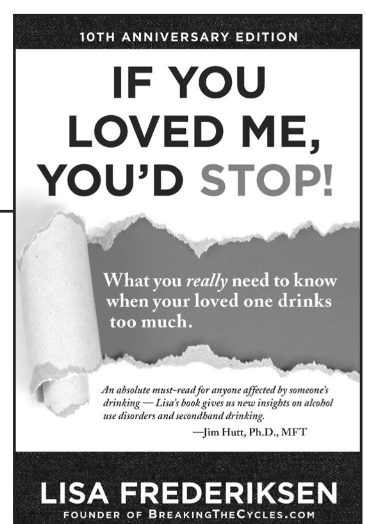
CHANGING THE CONVERSATIONS
BREAKING THE CYCLES
WITH LISA FREDERIKSEN

BASIC BRAIN FACTS
BRAIN WIRING, MAPPING, & DEVELOPMENT

Key to understanding a person's drinking (or other drug use) and its impact on family members and friends, and to explain:

- How a person develops and treats an alcohol or other drug use problem
- What happens when a person has co-occurring disorders (a drinking or drug use problem and a mental health disorder at the same time)
- Why experiencing ACEs (Adverse Childhood Experiences) changes how a child's brain wires and maps and has such a significant impact on their emotions, behaviors, and physical health across their lifetime
- Why coping with a loved one's drinking or other drug use problems causes toxic stress for family members and friends
- What toxic stress does to a person's overall physical and emotional health and quality of life
- What family members and friends can do to help themselves whether or not their loved one stops their drinking or other drug use
- Why others, like educators; treatment and medical professionals; family law practitioners; juvenile and criminal justice professionals; community, business, and public policy leaders; and others whose work involves substance use disorders and their impacts on family members, co-workers, and the community-at-large, can benefit from knowing these basic brain facts, as well.



Author, speaker, consultant, and founder of BreakingTheCycles.com, Lisa Frederiksen shares Chaper 4: Basic Brain Facts from her latest book, *10th Anniversary Edition If You Loved Me, You'd Stop!* Her book is available at local bookstores, libraries and online retailers.

Chapter 4
Basic Brain Facts

As I've mentioned, advances in imaging technologies now allow scientists and medical professionals to observe and study the live, conscious human brain like never before. The resulting findings – some in just the last 10-15 years – are revolutionizing our understanding of this three-pound organ. Think of it. Just three pounds, just a fraction of our total body weight, and yet it controls *everything* we think, feel, say, and do.

If our brain doesn't work, we can't feel pain or love or run or drive a car. If our brain doesn't work, our heart can't pump, our lungs can't breathe, and our limbs can't move. If our brain doesn't work, drinking alcohol and toxic stress would have no effect on our thoughts, feelings, and behaviors. So, it's knowing the basic facts about how our brains work that will help you understand:

- how drinking alcohol can hijack a loved one's brain and what can be done to return their brain to health (explained in Part 3)
- how the physical and emotional health and the very quality of a family member's life is so dramatically changed by repeatedly coping with a loved one's drinking behaviors and what can be done to reverse these impacts (explained in Part 4).

Personally, I found these basic brain facts life-changing because they answered so many of the questions I had. "Life-changing" is also the description given by so many of the people with whom I've worked when they learn of this research, as well.

Take It Slowly and "Take Away" What's Important

You are going to be seeing a lot of "science-y" information in this chapter, so try reading it as you would a novel – nothing to struggle with, just a worthwhile read to pick up and set down as time and interest allows. The brain is complex, and no one expects you to grasp all of this information at once. But knowing some basic facts about how the brain works will give you a much better understanding of how alcohol and toxic stress get in the way of it working properly. I've included "Take Away" paragraphs at the end of each section to give you a quick summary of what you'd just read.

The Brain's Communication System

To gain a general understanding of the brain, it helps to start with recognizing the brain's extraordinarily complex neuron-to-neuron communications system. This system involves an electro-chemical signaling process. That process is commonly referred to as neural networks, neural circuitry – or more simply, as brain wiring.

It is through this electro-chemical signaling process that neurons in the brain (typically called brain cells) "talk" to one another and to and from other neurons throughout the body via the nervous system. This "talking" is how the brain controls *everything* a person thinks, feels, says, and does. That control includes walking, reading, reacting to emotions, talking, and worrying about a loved one, as examples. It also includes how a person develops a drinking problem or experiences toxic stress consequences as a result of repeatedly coping with a loved one's drinking behaviors.

How Neurons Talk to One Another

You can see how neurons "talk" to each other through the electro-chemical signaling process by looking at Image 4.1. The terms discussed below will give you more details on this process. Remember, you do not have to absorb all of this information; you only need to grasp the overall picture, so here are the terms that will be useful for gaining this insight:

Neurons. These are specialized cells designed to receive, process, and transmit information (in the form of an electrical signal) to and from other neurons. There are three types of neurons: *sensory neurons*, which bring information *into* the brain; *interneurons*, which process information *within* the brain; and *motor neurons*, which carry information *out* of the brain to the body's muscles via the nervous system.[22] When discussing the brain, neurons are often referred to as "brain cells." Basically, then, neurons generate or receive *the electrical signaling portion* of the electro-chemical signaling process.

Branch-like extensions. These carry outgoing and incoming electrical signals from one neuron to the next.

Neurotransmitters. These are *the chemical part* of the electro-chemical signaling process, located at the end of outgoing branchlike extensions. These chemical messengers change the electrical signal into something that can "float" across the gap, called a synapse, between two branchlike extensions.

Synapse. The gap between outgoing and incoming branchlike extensions. There can be hundreds to thousands of synapses on any one neuron, and there can be trillions of synaptic connections occurring at any one time.[23]

Receptors. These are located at the end of incoming branchlike extensions. They accept the neurotransmitter – like a "key in a door lock" – and change it back into an electrical signal that travels up the branchlike extension to the receiving neuron. That neuron may send its own electrical signal and continue the process or end the message.

Without Neurotransmitters and Receptors, One Neuron Cannot "Talk" to Another

Recall the description I gave in Chapter 2 about how ethyl alcohol is processed in the body and how when it backs up, waiting its turn to be processed out of the liver, it changes brain functioning. That's because the excess ethyl alcohol chemicals in alcoholic beverages change or interrupt neurotransmitter/receptor connections throughout the brain. When these "normal" connections are interrupted, the "normal" messaging of those neural networks are also changed. This is why drinking too much alcohol can change a person's thoughts, feelings, and behaviors and result in drinking behaviors like those I described in Chapter 1.

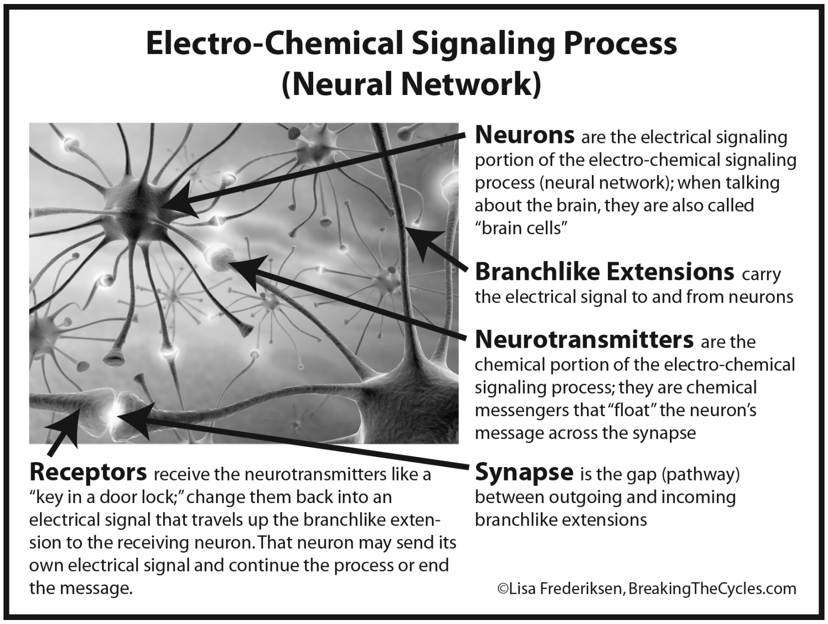


Image 4.1 Illustration of the Electro-Chemical Signaling Process, also known as Neural Networks

Cues Start the Process – Sometimes as Fast as a Light Switch

Now that you've read the explanation of how neurons "talk" to each other, you may wonder what starts the "conversation." Those conversation starters in the brain are called "cues" or "triggers." These cues can be sound, sight, touch, smell, memories, emotions, or anything else that gets a neuron to start its electrical signaling.

The tricky thing about cues is they can trigger neural networks into action as fast as turning on a light switch. Think about that. If you flip the light switch on, before you can blink, the electrical current arrives at the light bulb, and the light is on. That is how fast some of our neural networks can activate. And therefore, that's how fast we can engage in a behavior without "thinking," like jumping out of the way of an oncoming car without taking time to ponder, “Oh my, that car is going to hit me. What shall I do?”

For someone with an alcohol use disorder, for example, a cue to start drinking, may be the sound of a beer can tab being popped open, the smell of a glass of wine, or the face of a timepiece showing it’s 5:00 o’clock in the afternoon. For a family member coping with a loved one’s drinking behaviors, a cue to start worrying or getting angry may be the sound their loved one’s key makes when they’re fumbling with trying to open the door, or the noise of their stumbling footsteps down the hallway, or the droop of their eyelids and the frequent licking of their lips when talking to you after stopping off with friends for drinks on the way home. All of this discussion about cues and triggers will make more sense when you understand brain wiring and mapping, and we’ll get to that in the next section.

Thank Goodness for Synapses

Just think. If there were no synapses (gaps between branchlike extensions), then all of our neural networks would be stuck in the “on” position. We would be trying to sleep, sit, talk, run, read, do math, eat…ALL at once. Thus, the health of what happens at these synapses and along a neural network is critical to the brain’s “motor control,” “reacting,” and “thinking,” and thereby to the brain and body’s overall health and functioning.

Too much or not enough of a neurotransmitter, not enough receptors, unhealthy neurons, or too much or not enough of some of the other key components to a successful neural transmission (which are too extensive to explain here) can drastically change how we think and feel and what we say and do.

Take Away: *The electro-chemical signaling process (neural networks) is (are) the first step in building a brain. If neurons can't or don't talk to one another in the brain, there is no way they can talk to and from others throughout the body.*

Location Matters: Regions of the Brain

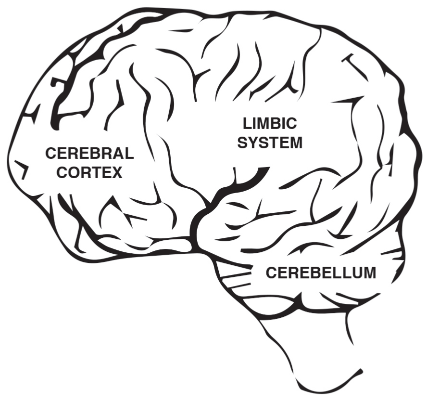
Now that you know a little about how the brain "talks" through its neural networks, the next basic brain fact to understand is the concept of brain regions. Science has organized the brain into three general regions or "sub-brains" (see Image 4.2 below). These sub-brains are the Cerebellum, the Limbic System, and the Cerebral Cortex.

Each of these three sub-brains contains neural networks that are involved in a different part of the overall scope of human activity. And, they follow the human brain's evolution and development.

Note: Within each sub-brain, there are many, many parts or "sub-areas." In the Limbic System, for example, there is the amygdala, hippocampus, and hypothalamus, to name a few. In the Cerebral Cortex, there is the pre-frontal cortex, often referred to as the "executive center" of the brain. These sub-brains or "regions" are also referred to by various names. The Cerebellum, for example, is often called the Reptilian brain, and the Limbic System is also known as the Mammalian brain.

Where in the Brain the Neural Network Activity
Occurs Determies Thoughts, Feelings, Behaviors

The "3-Brain" Brain Complex



Cerebral Cortex = higher level thinking
(referred to as the **"thinking"** part of the brain because neural networks here control reasoning, judgment, motivation, perception, decision-making)

Limbic System = survival-type functions
(referred to as the **"reactionary"** part of the brain because neural networks here control fight-or-flight, pleasure/reward, pain, and emotions)

Cerebellum = motor movements
(referred to as the **"motor movements"** part of the brain because neural networks here control functions like breathing, heartbeat, and motor skills)

There are many sub-areas within each area: Amygdala in the Limbic System and Prefrontal Cortex in the Cerebral Cortex, as examples.

Image 4.2 – "3 Brain" Brain Complex – Regions of the Brain

I want to call your attention to the activity of the Limbic System in particular. This is because it's the part of the brain that most concerns us when it comes to alcohol use disorders and the toxic stress family members typically experience when they repeatedly cope with a loved one's drinking behaviors. This is because Limbic System neural networks control our survival instincts and functions: pleasure/reward, fight-or-flight, pain, and emotion.

Alcohol triggers the pleasure/reward neural networks. Coping with a loved one's drinking behaviors triggers the fight-or-flight stress response neural networks. As you continue reading, you'll learn more about the important role of the Limbic System. For now, however, the primary objective of Image 4.2 is to help you understand there are three general groupings of brain activity responsible for everything we think, feel, say, and do.

Take Away: *The brain has three main regions or "sub-brains." They include the Cerebellum, responsible for "motor movements;" the Limbic System, which is the "reactionary" part of the brain; and the Cerebral Cortex, which is the "thinking" part of the brain. The neural networks in the Limbic System are of particular interest because they control survival instincts and bear the brunt of the impact of alcohol or toxic stress on our own or a loved one's thoughts, feelings, and behaviors.*

Brain Wiring and Mapping for the Things We Do

When you look at Image 4.2, it becomes obvious that neural networks have to connect from one region of the brain to another and then to and from neurons throughout the body in order to make our lives possible. And this is where the concept known as brain wiring comes into play. Basically, brain wiring is the brain "hooking" together neurons/neural networks to make the things we think, feel, say, and do possible.

Picture Brain Wiring to be Like Plugging Strands of Holiday Lights Together

To give you a visual image of how this "hooking together" of neurons (this brain wiring) works, think of strands of holiday lights plugged into strands of holiday lights plugged into even more strands of holiday lights. People connect these strands to light the holiday scenes they set up in their front yards.

One series of strands may light the tree, another the Santa, another the reindeer, and several more illuminate the house trim and candy canes lining the walkway. Some are white, others red, and still others are multi-colored. When all are plugged in together, neighbors and visitors see an entire scene – not just *a* Santa, *a* reindeer, or *the* house trim. If the lights go out on the Santa or they go out on the tree or several of the candy canes lining the walkway, the holiday scene is dramatically changed.

Similarly, brain wiring connects a variety of neural networks to each other. Changes in one area of those connections can change the way the other connections work, which in turn changes the "original" thought, feeling, or behavior.

Brain Wiring

Some of our brain wiring is instinctual, hardwired, and built in to being human – meaning we don't consciously hook those neurons/neural networks together. These are the series of neural network connections that form systems between the brain and other organs in order to control our body's major functions. These are the systems we are born with. These include the fight-or-flight stress response system, for example, as well as the circulatory and digestive systems. They are what make our heart pump, our blood circulate, and our lungs breathe from the moment we are born. These systems control our instinctual drives to eat food when hungry, drink water when thirsty, sleep when tired, or fight or run when confronted with danger.

The majority of our neural networks, however, connect by repetitive activation. Meaning, we repeat the thought, feeling, activity, or behavior over and over, again, until the brain connects the series of neural networks so they engage without thought. This is the concept of "pushing new synapses" – connecting one neuron to another and another and another.

The process of learning to ride a bike is one example of the repetitive activation of a series of "strands" of neural networks. Riding a bike requires engaging the neural networks responsible for seeing, balancing, peddling, and listening for cars, as well as recognizing and knowing the meaning of road signs and rules, braking, and responding with reflexes to swerve out of the way of a dangerous object. The whole process of hooking together the neural networks – the brain wiring – needed to ride a bike takes some serious time. Think training wheels and a lot of skinned knees.

When practiced over and over, however, these neural networks eventually work together on autopilot, and the child, teen, or adult is now "riding a bike." Other examples of the repetitive activation of neural networks (brain wiring) include those involved with learning to walk, becoming a great athlete, speaking a new language, or typing on a computer.

Neuroscientist Carla Shatz summarizes this wiring process as: "Neurons that fire together wire together."[24]

Brain Mapping

Dr. Carla Shatz goes on to say that this "firing together, wiring together" process – whether it's instinctual or repetitively activated – causes the brain to form embedded "brain maps"[25] for the things we think, feel, say, and do regularly. These embedded brain maps, then, become our habits, our go-to-behaviors; they're how we move through our days.

And thank goodness we have brain maps. If we didn't, we would still be trying to get out of bed. The complex series of neural network connections needed to do that simple function would take forever to hook together if we had to first think of and then perform each next step in the connection series.

So, over the course of our lives, we create brain maps for walking, brushing our teeth, driving a car, swimming, operating equipment, handling stress, expressing our opinions and feelings (or not), playing an instrument, texting – just think about it! This also explains why a person who has learned to ride a bike can give it up for a while, but when they hop on that bike years later, their bike riding brain maps kick in. They may be a bit wobbly at first, but it's not long before they are again riding a bike. It was "mapped."

Another example is learning to read. It is a *years long* process to become an adult reader. But those adult-reading neural networks are so embedded that it's impossible not to instantly read when a piece of paper with words is put in front of you.

This same analogy is true for a person who has a severe alcohol use disorder (alcoholism). They can stop drinking for years, but if they start again, it's not long before they activate all their alcoholism-related brain maps, and they are back in it, again. Why this happens is more fully explained in Part 3.

Take Away*: The phrase "brain wiring" refers to the brain's ability to "hook" together the neurons/neural networks that make the things we think, feel, say, and do possible. You can think of this wiring as being similar to strands of holiday lights all plugged together – where what happens to one strand affects all the others. "Brain mapping" is when sequences of brain wiring are repetitively activated, allowing us to form "brain maps" for the things we think, feel, say, and do regularly. Some of our brain wiring and brain mapping is already in place (hardwired) at birth to allow for survival-type functions, like breathing. But most are by repetitive activation, like those involved with riding a bike or reading. These same brain maps can also become distorted by the misuse of alcohol or toxic stress, explained in later chapters.*

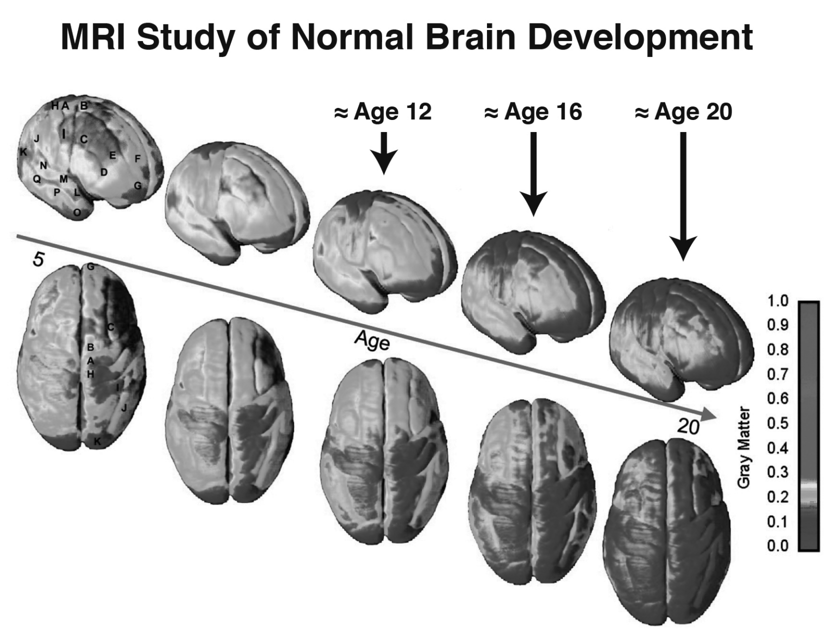
Brain Development: One of the Most Profound Influences on How Our Brains Wire and Map

Brain development – the growth of the brain from the time we are in utero until we mature – is one of the lesser-known factors that has a dramatic influence on how our brains wire and map.

I'm going to take a little time to explain brain development in this section, which is somewhat longer than others in this chapter. It has so many basic brain facts that will be useful for you – not only in regard to a loved one's drinking but also to many aspects of your own life.

The first thing is to look at Image 4.3 below. It is a 10-year time-lapse study showing scans of the brain taken at various stages of development from ages 5 through 20. Above the line are side views. Below the line are top-down views. The bluish, purple colors (darker colors when viewed in black and white) represent brain maturity (brain development).

I have added the approximate ages to the original images to give you an idea of how much change occurs. It is now understood the brain continues important developmental changes through age 22 on average for girls/women and 24 for boys/men. [Note: in general terms (not distinguished by gender) human brain development is referred to as occurring in utero through age 25.] I explain these developmental changes below Image 4.3.



The decade-long magnetic resonance imaging (MRI) study of normal brain development, from ages 5 to 20, by researchers at NIH's National Institute of Mental Health (NIMH) and University of California Los Angeles (UCLA) Source: Paul M. Thompson, Ph.D., Laboratory of Neuro Imaging, UCLA, NIMH/UCLA Project. Reprinted with permission from Dr. Paul Thompson.

Image 4.3 MRI Study of Normal Brain Development, ages 5 to 20.
Courtesy Paul M. Thompson, Ph.D

The First Decade or So

We are born with approximately 100 billion brain cells (neurons), which is about the number of brain cells we have as adults. If the majority of our neural networks were wired at birth, we would come out doing what we do as adults. But about all a newborn baby's neural networks do is allow it to breathe, eat, sleep, cry, smile, and dirty the diapers – those instinctual, hardwired systems I explained previously. And by the way, the fact that a newborn arrives with these capabilities means there is brain development during pregnancy, as well.

About Drinking During Pregnancy

The fact a newborn comes out with the basic survival capabilities for breathing, eating, sleeping, etc., means there is brain development during pregnancy. This is why the Centers for Disease Control and medical professionals advise pregnant women not to drink during pregnancy. The alcohol in the mother's bloodstream passes directly to her fetus through the placenta. Because the growing fetus does not have a fully developed liver or other organs, it's unable to metabolize the ethyl alcohol, which is what makes a mother's drinking during pregnancy harmful to her baby.[26]

So, from birth to about age three, our neurons wire at an explosive rate, guided primarily by our responses to touch, sound, sight, smell, and taste. After all, we aren't reading at age two, so we cannot learn from a book or instructions on a computer. This means long before our conscious memories are formed, our brains are wiring in response to what is happening around and to us, as well as to our genetic (hereditary) traits.

Then from about age four until puberty, our neural networks continue to wire and rewire. Think of this in terms of our newfound abilities to engage in sports, do math, learn languages, or play music. In this first decade of life, a child's brain forms trillions of neural networks because everything a child thinks, feels, says, and does requires them.

This is why factors such childhood trauma (verbal, physical or emotional abuse, neglect, coping with a parent's drinking behaviors, being bullied), genetics (heredity), and social environment (home, school, friends, neighborhoods) have such a significant influence on the development of a child's brain and the brain maps that are forming at this time. These factors continue to have a profound influence on brain wiring and mapping through our early 20s. They are also key risk factors for developing alcoholism, by the way (also explained in Part 3).

And, then… just at the time when science used to think the work of brain development was "done" – hardwired – it turns out the brain goes through three more developmental processes beginning around age 12 with the onset of puberty and continuing through a person's early twenties (often through age 25!).

Pushing New Synapses

The idea behind brain development or changing an existing brain map is the concept of "pushing new synapses." When a child/teen/adult learns something new, they "push new synapses," meaning they connect the series of neural networks needed to perform this new function. If the new function is to replace an old one (like a bad habit) or create a new one altogether, the repetitively activated new series of neural networks becomes the embedded brain map.

Creating a new brain map by "pushing new synapses" is how a person changes a drinking pattern, including healing their brain of alcoholism. It is also how a family member changes the way they cope with a loved one's drinking behaviors. They push new synapses. Suggestions for how to do this are explained in later chapters.

Brain Changes with the Onset of Puberty Around Age 12

Puberty is an instinctual wiring process. We don't decide if or when to do it. And it is a wiring process that was critical to the survival of the human species back in the days of early humans. You have to remember that early humans had a very simple life – no cars, computers, jobs, schools, houses, books, or machinery. And they had a very short lifespan of about 25 years.

So, about the only neural networks they needed at the time were those in the Cerebellum and Limbic System. There was not a lot of

Cerebral Cortex wiring because the “needs” (the cues/triggers) to push those kinds of synapses weren’t part of life for early humans. Early humans did, however, need the wiring that occurs with the onset of puberty, especially that which occurs in the Limbic System (the reactionary – not thinking – part of the brain). That’s because the “purpose” of puberty is to cause brain changes that motivate humans to turn to their peers and take risks. It is also to take care of the obvious – causing humans to develop adult-like bodies capable of reproducing – and the not so obvious – to experience hormonal changes to “make” the brain/body want to have sex so that it did have sex and reproduce.

These three instinctual drives (take risks, turn to peers, and reproduce) were critical to the survival of the human species in earlier times when humankind had that simpler, shorter lifespan of about 25 years. That shorter lifespan meant parents were likely dead, unable to protect a child from around age 12 on; hence the importance of puberty to the survival of our species.

The problem for tweens and teens in modern times, however, is these brain wiring changes still occur with the onset of puberty, but the part of the brain needed to make “adult-like” decisions is not wired. That kind of wiring doesn’t really get underway until around age 16.

Understanding the point of puberty was a real eye-opener for me when it came to understanding the dramatic shifts in interests and temperament I saw in my daughters as they moved from elementary school to middle school. It explained the sudden interest in body image, boys, and peer groups, and their seeming indifference to my wisdom and guidance. And what happens in the next phase of brain development explained even more reasons for this shift.

The "Thinking" Part of the Brain

There is about a four-year lag time between the start of puberty at around age 12 (on average) and the next stages of brain development that generally start around age 16 (on average). These next stages can take until age 22 on average for girls/women and 24 on average for boys/men. They include:

- continued wiring in the cerebral cortex, the "thinking" part of the brain, especially that which occurs in the prefrontal cortex, the "executive center" of the brain
- the "pruning and strengthening" process.

It is this continued wiring in the Cerebral Cortex, especially the prefrontal cortex, that allows a young person to engage in sound reasoning, good judgment, complex planning, and appropriate impulse control, as well as weighing the consequences of their actions, and learning from their mistakes.[27] This continued wiring also serves as the brakes on the risk-taking behaviors that started with puberty.

And it is the "pruning and strengthening" process that allows the brain to organize itself more efficiently. Because, let's face it, everything that child has been thinking, feeling, saying, doing repeatedly has been wiring as brain maps. To sort through and make the brain more efficient, then, the brain "strengthens" those being frequently used – the ones being repetitively activated. It does this by wrapping them in a fatty tissue called myelin to make the neural connections more efficient. The purpose of this myelin wrapping is similar to the idea of an insulated cable wire being a better conductor than a non-insulated one.

Those maps that are not being repeatedly activated get "pruned." It's not that they "die" necessarily. Rather, the brain misses some important neural network wiring, mapping, and strengthening opportunities.

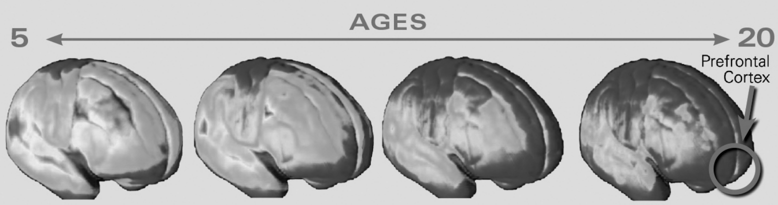
Without the Experience / Memory, There Is No "There" There

Until a tween/teen's brain experiences something and has a memory of the outcome, that tween/teen has a difficult time believing or appreciating someone, like their parent, telling them how it's going to be if they don't do x, y, or z. I know I would give long-winded lectures to my daughters on the importance of doing something or ignoring the mean girls or not being hurt when a boy didn't ask them out because it "wouldn't matter in five years." I did not know then that until a child has had an experience and stored the outcome into long term memory in order to know or appreciate what you say is true, it's like talking to the wall. No wonder my girls would give me a blank look that expressed something like, "You have no idea!" And, frankly, no wonder I did the same to my parents. At age 14, that's as far as my daughters' (and my own) experiences/memories had mapped. We had no point of reference to understand (let alone believe) it wouldn't matter in five years.

Image 4.4 below was created by the National Institute on Drug Abuse (NIDA)[28] and is similar to Image 4.3, but it includes class pictures. These class pictures drive home these concepts. Notice, especially, how long it takes the prefrontal cortex (circled in red in the last scan) to develop. And as I've said, this prefrontal cortex is the "executive center" of the brain. It is the neural networks in this part of the brain that "powers the ability to think, plan, solve problems, make decisions, and exert self-control over impulses. This is also the last part of the brain to mature, making teens most vulnerable (NIDA)." [29]

The brain continues to develop into adulthood and undergoes dramatic changes during adolescence.

One of the brain areas still maturing during adolescence is the prefrontal cortex—the part of the brain that enables us to assess situations, make sound decisions, and keep our emotions and desires under control. The fact that this critical part of an adolescent's brain is still a work in progress puts them at increased risk for poor decisions (such as trying drugs or continuing abuse). Thus, introducing drugs while the brain is still developing may have profound and long-lasting consequences.



Blue represents maturing of brain areas.

Source: National Institute on Drug Abuse (NIDA) – see endnote 28 for location

Image 4.4 – Brain Changes Ages 5-20 With Class Pictures. Source: National Institute on Drug Abuse (NIDA) – see endnote 28 for location

Take Away: *This lag time between the start of puberty and the completion of the Cerebral Cortex wiring and mapping (especially that which occurs in the prefrontal cortex) helps explain why tweens/teens make poor "decisions." When we think about it, there is no way we* *would give our 12-year-old the keys to the car (class picture 2nd from left) and tell them to go practice driving, especially on the freeway and during commute hours, so they're good and ready when they take their driver's test at 16 (class picture 3rd from left). Well, the same is true of so many other adult-like decisions we expect from teens but which they are unable to fully execute without benefit of these final brain developmental stages.*

This lag time also helps explain why "Just Say, 'No'" campaigns to deter destructive tween/teen behavior typically don't work and why early use (drinking before 21) is a key risk factor for developing alcoholism or other drug addictions as explained in Chapter 6.

The Good News: The Brain is Far From Hardwired

This new brain research has debunked some of society's other long-held beliefs about the brain. These include the belief that our brains were hardwired by around puberty and that from then on, it was in a long, slow process of decline; or that heavy drinking (or other drug use) "killed" brain cells; or that you only used a very small percentage of your brain's capacity. Debunking these kinds of long-held beliefs is the result of research around the concept known as "neuroplasticity."

As Dr. Norman Doidge writes in his book, *The Brain That Changes Itself,* "Ironically, some of our most stubborn habits and disorders are products of our [brain's] plasticity. Once a particular plastic change occurs in the brain and becomes well established, it can prevent other changes from occurring. It is by understanding both the positive and negative effects of [the brain's] plasticity that we can truly understand the extent of human possibilities."[30] In other words, our brains have an incredible capacity to repair, to heal, to rewire, and thereby we have the incredible capacity to change our thoughts, feelings, and behaviors. This includes those involved with an alcohol use disorder or coping with a loved one's drinking behaviors.

Neuroplasticity – Good and Bad

It is the brain's ability to wire and map that explains how a person *develops* an alcohol use disorder or toxic stress consequences when repeatedly coping with a loved one's drinking behaviors. At the same time, it is also the brain's ability to wire and map that gives a person the power to wire new brain maps to *stop* an alcohol use disorder or change how they cope with drinking behaviors.

Look at my mom and me. I was almost 50 years old when I started my brain rewiring recovery from almost four decades of coping with various loved one's drinking. My mom was 79 when she started her brain rewiring recovery from 45 years of alcohol use disorders. Thank goodness it's never too late to start!

Understanding the basic brain facts I've shared in this chapter lays the groundwork for understanding what happens when alcohol hijacks the brain. It also lays the groundwork for understanding what happens to family members and friends. And it is these understandings that can give you a road map for changing *your* life for the better, whether you continue your relationship with your loved one, end it, or redefine it.