Symphony in the Brain

Brainwave biofeedback – **the simple science of quantifying subtle electrical information from a person's brain, amplifying it, and sharing it with that person, who can then control the information in a way that makes the brain more vigorous and able to do a better job of managing body and mind.**

Neurofeedback is neither miracle nor panacea. It is science that turns the way we have categorized and thought about illness upside down.
It is being used to treat not only epilepsy and learning disabilities, but also a long list of other problems that defy conventional treatment: cocaine, alcohol, and other addictions; vegetative states; serious and mild head injuries; autism; fetal alcohol syndrome; discomfort from menopause and premenstrual syndrome; chronic pain; the symptoms of multiple sclerosis and Parkinson's disease; stroke; post traumatic stress disorder; wild hyperactivity; Tourette's syndrome; depression; cerebral palsy; and much more.

Neuroplasticity – the idea that the brain is not static but capable, if given the right stimulation, of dramatic and long-lasting change.
Exerting the brain in new ways through the course of life creates new neuronal pathways, more synaptic connections, and significantly more cortex – a bigger and healthier brain.

The cortices of the enriched brain are thicker; the number of glial cells, which play a role in supporting neuronal activity, are greater; and individual neurons have more elaborate branches and an increased number of connections to other cells than those of the impoverished brain.

The brain weighs about three pounds, is about 90 percent salt water, and has the consistency of a ripe avocado. There are four distinct regions to the brain. The top layer is the cortex, and there, especially in the front of the cortex, is where reason, planning, writing and reading, and a host of other cognitive functions take place. The cortex is what makes us human, what distinguishes us from the rest of the animal kingdom, by mitigating our baser instincts.

It looks like the covering of a tree trunk, and the name ***cortex*** is Latin for bark. Beneath the cortex is the mammalian brain, or the limbic system, the portion of the brain that governs pain and pleasure, including feeding, fighting, fleeing, and sex. Below that is the diencephalon, which regulates our sleep and appetite. The bottom layer is the primitive regulatory machinery, the reptilian brain. This region is concerned with function –breathing, blood pressure, movement, and body temperature.

Information comes into the brain from the external world through the senses and is converted to an extremely complex mixture of electrical and chemical energy. The four parts of the brain, as well as myriad areas across the surface of the cortex, must "talk" to one another constantly, and the brain accomplishes that by means of its vast assembly of tiny electrical devices, the neurons or brain cells. Neurons are like microscopic batteries. Their membrane builds up a charge electrochemically and then releases it, over and over again, in the form of what is called an "action potential," a surge of voltage that propagates down the axon to where it terminates on other neurons. Cells fire in unison to create thought and movement, and information travels around the brain in networks. Neurofeedback rouses the conductor and resets him to his appropriate speed.

As frequency increases during a neurotherapy session and the brain is activated, more blood than usual streams to that area of the brain – the nutrients in the blood may be strengthening or reorganizing existing connections, which increases the cells' ability to self regulate. The neurofeedback model holds that the brain wave training increases the stability of that area of the brain as well as its flexibility, or its ability to move between mental states (from sleep to consciousness or arousal to relaxation, for example). It allows the players in the orchestra to play their parts better, to find the correct tempo, to come in on time, and to stop playing when they aren't needed. Since every aspect of a person is driven by an assembly of neurons, the healthier those neurons are, the healthier are the functions that they govern.

What's been added to the body of knowledge bout stress in recent years is the profound impact that emotions have on the nervous system. A stress chemical called cortisol is emerging as a primary player in damage to the brain. It's the master stress hormone. In low doses it alerts us and organizes our behavior so we make sure to protect ourselves. But in higher doses it leaves us stressed out,

inattentive, disorganized and depressed. Severe stress affects the size of the structure (in the brain), cell death, and the number of connections between brain cells.

And earlier in life the brain is much more vulnerable to insult. Topping the list of stressors, as numerous studies attest, is an absence of solid, caring relationships. A car wreck is bad, for example, in terms of stress, but its not as bad as being neglected, isolated, or ostracized by your peers. Deprivation – lack of love, comfort, security – is very stressful and can have big time effects. A study at the University of Minnesota showed that children who have a poor emotional attachment to their parents get higher rushes of cortisol during even mildly painful events, such as being vaccinated, than do children with strong parental bonds.

Research has shown that sustained exposure to cortisol can cause serious damage to the hippocampus, which affects memory, mood regulation and interpretation of space. Some researchers believe cortisol may also cause damage to other parts of the brain, notably the left prefrontal cortex. This region of the brain, right behind the forehead, is vital to humans, orchestrating emotion, arousal and attention and providing a restraint mechanism that keeps people from acting on impulse. It is key in teaching a child to feel remorse and establish a conscience. In fact, the prefrontal cortex is known as the "Organ of Civilization" because it is largely what distinguishes us from animals.

Karl Pribrum at WinterBrain 2005 quote. . .

According to work at the University of Wisconsin and elsewhere the left prefrontal cortex plays a key role in integrating positive emotion into people's lives. The tiny bit of tissue drives the networks in the brain that make us feel good, while the right side drives anger, fear and other negative emotions. When the frequency of the two sides isn't balanced and the right side is higher than the left, people can't engage their positive emotions and become depressed.
Some research has shown stress has an extremely deleterious effect on the prefrontal cortex. In children who have been severely neglected, key portions of their brain don't develop properly and are nearly a third smaller than the brain of a normal child of similar age. And with key areas of the brain undeveloped, problems arise. . . .

For a long time there were two basic approaches to neurofeedback. Generally, those who do beta, or 15 – 18 hertz SMR training on the left side of the brain, feel alert, and those who do 12 – 15 hertz training on the right side feel calm. Siegfried Othmer believes deeply that neurofeedback is a revolutionary system, a powerful and precise way to manage the human central nervous system, something that is currently managed in only a gross and haphazard way, primarily with drugs. It hands responsibility for that management to the people themselves. It democratizes one of the most important things on the planet: the human nervous system. The change is so dramatic, he says, that it is akin to what biologists and paleontologists call **punctuated equilibrium**, a sudden and powerful burst of evolution off in some isolated part of the population that gives it an advantage, while the rest of the population continues on its plodding course. Such leaps, he says, don't come from within the field; the come from outside or on the fringes.