

# #NAMIcon16

## Why Survivors of Trauma Feel and Act the Way They Do: Understanding the Neurobiology of Trauma



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# The Stress-Trauma Continuum

- Normal
- Situational
- Traumatic



# What is Trauma?

- Physical, sexual abuse, neglect
- Domestic violence
- Stalking
- Chronic marginalization
- School or gang violence
- Divorce/custody battle
- Losses
- Immigration
- War
- Natural Disasters
- Severe motor vehicle accidents
- Witnessing or hearing about any of the above

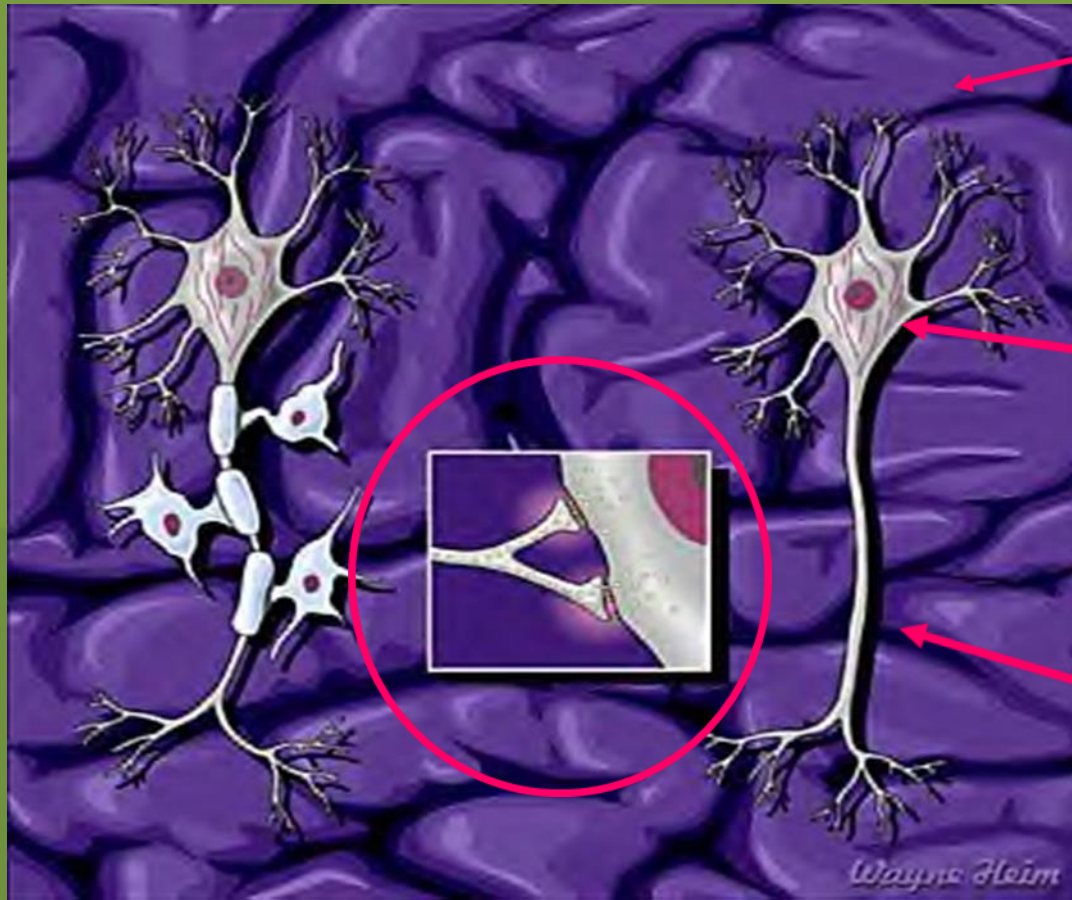


# Trauma Symptoms as Adaptations

- Substance abuse
- Indiscriminant sexual behavior
- Self-harm and suicidal gestures
- Dissociation
- Fighting
- Continued contact with the abuser
- The freeze response
- Avoidance or withdrawal
- Eating disorders
- Engaging in high risk behaviors



# Neurobiology of Trauma

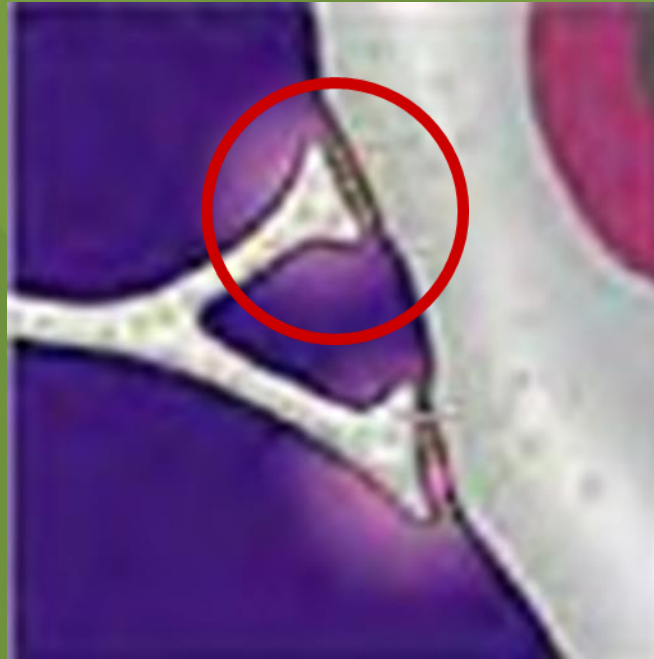


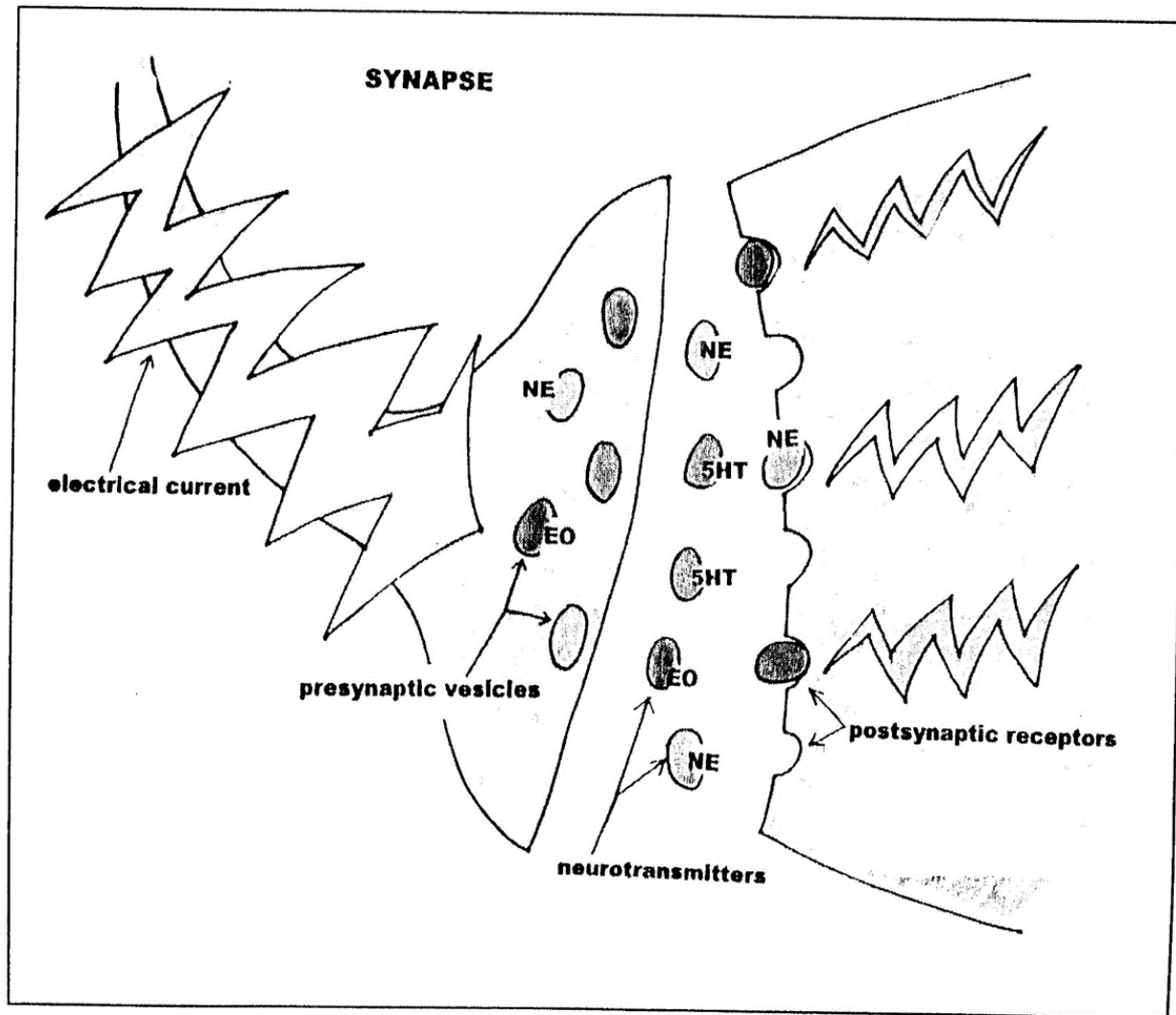
**Dendrites**

**Nucleus**

**Axon**

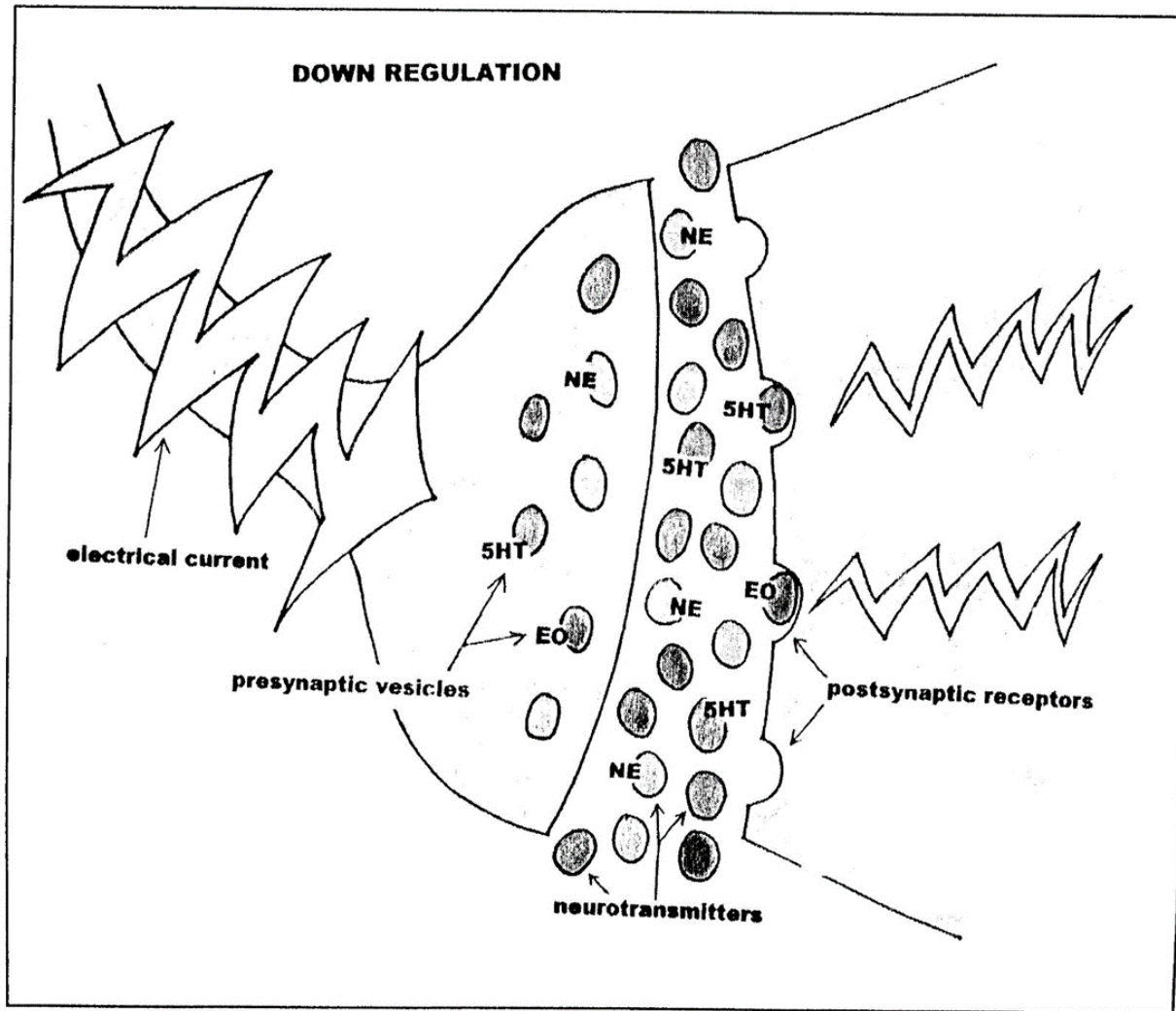
# Synaptic Activity





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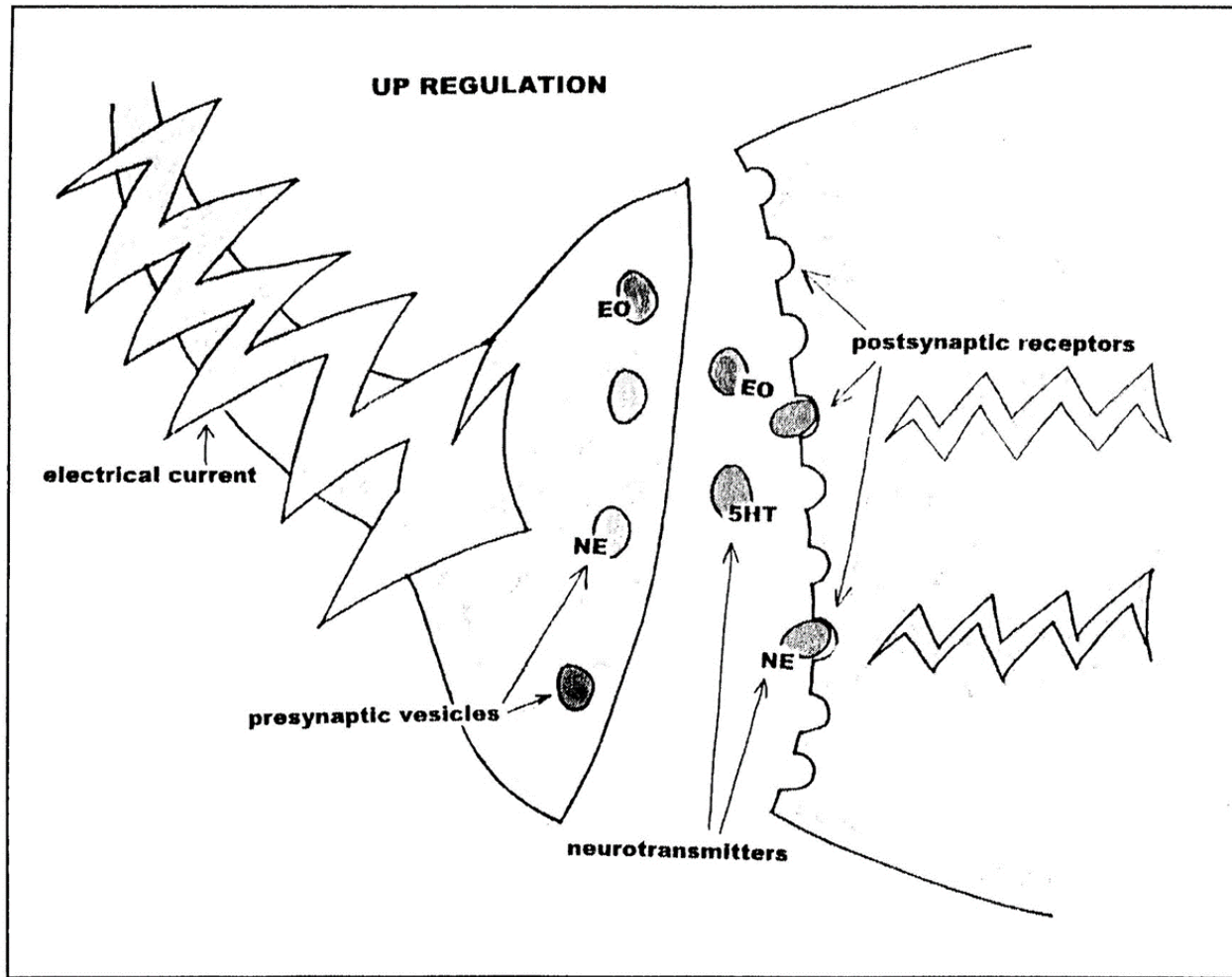




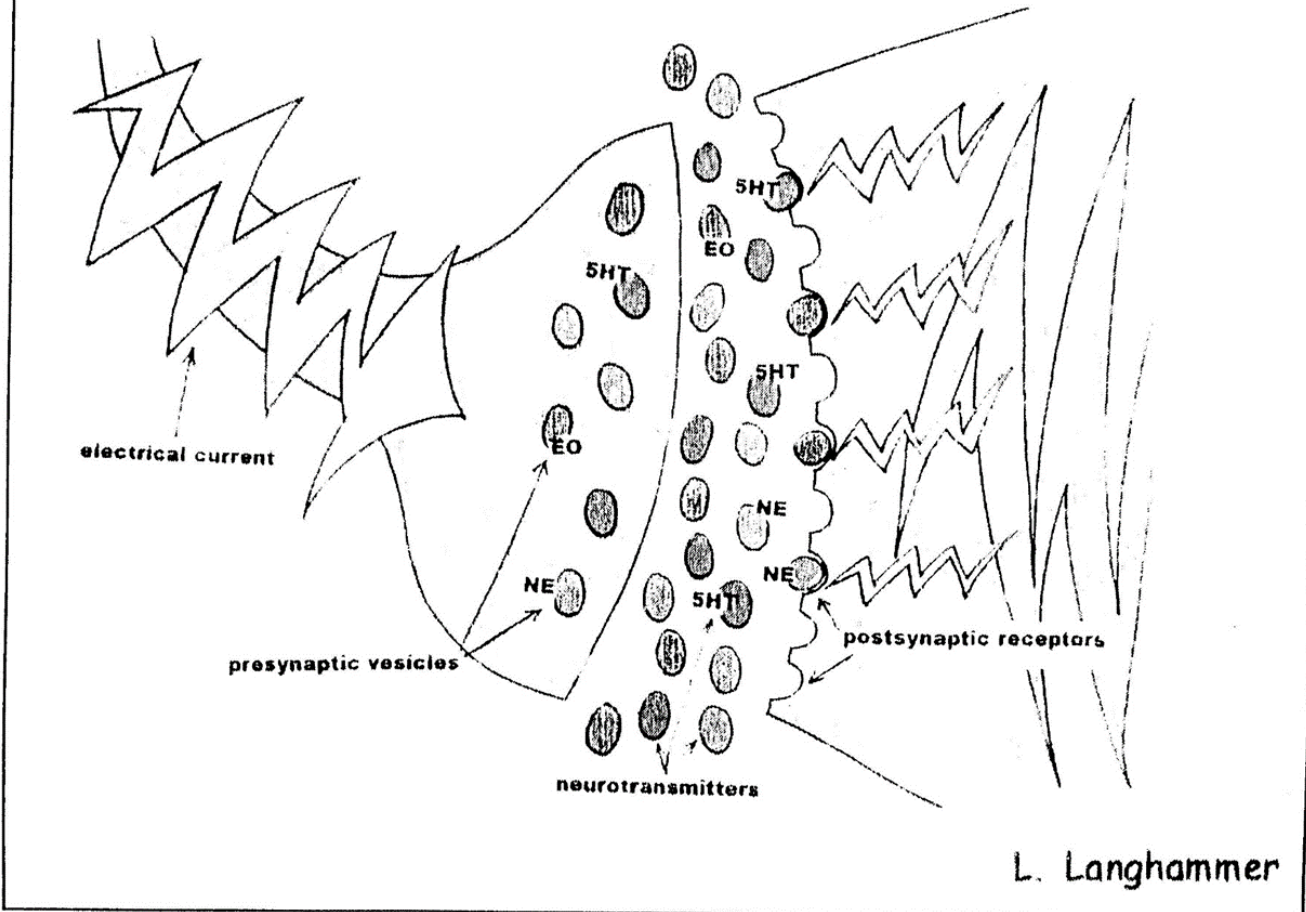
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# E. AMPLIFICATION



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# More on the Sympathic Nervous System Response

- HPA axis: hypothalamic-pituitary-adrenal
  - This system is responsible for bringing the body back into balance
  - The following chemicals/hormones are released:
    - Catecholamines (epinephrine and norepinephrine) – responsible for fight or flight
    - Corticosteroids (glucocorticoids, cortisol) – control energy and body's immune functioning
    - Opioids – prevent pain, inhibit memory consolidation
    - Oxytocin – inhibits memory consolidation, promotes good feelings
- These chemicals are **POWERFUL** substances ....



# Sympathic Nervous System Response

- **If trauma is too severe, too long, triggered often ... then:**
- **Catecholamines** are chronically increased; damage to memory, rational thought, hypervigilance, inability to distinguish danger signals
- **Corticosteroids** are chronically low; reduced immune functioning (lupus, Graves disease, RA, fibromyalgia), catecholamines aren't regulated
- **Opioid** levels increase (equivalent to 8 mg of morphine); flat affect
- **Oxytocin** increased— memory impaired; bonding to perp

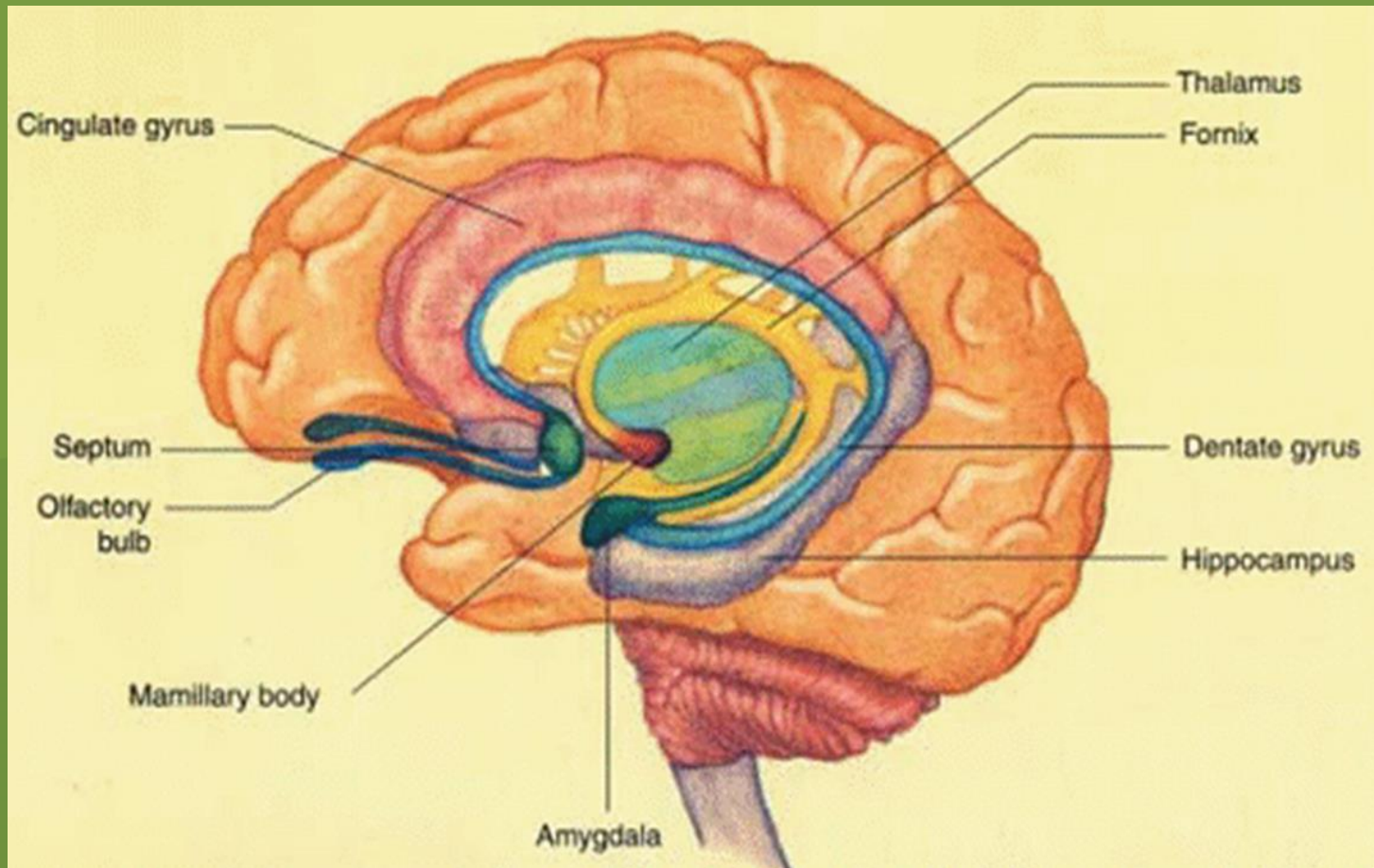


# Other Neurotransmitters of Importance

- **Serotonin** – inhibitory; involved in emotion and mood. Too little serotonin has been shown to lead to depression, problems with anger control, obsessive-compulsive disorder, and suicide.
- **Dopamine** – inhibitory (meaning when it finds receptor sites, it blocks the firing of the neuron); controls arousal, alertness, attention; vital for giving motivation; Drugs like cocaine, opium, heroin, and alcohol increase the levels of dopamine, as does nicotine.
- **GABA** – inhibitory; acts like a brake to the excitatory neurotransmitters that lead to anxiety.



# Structures of the Brain: The Limbic System





Neocortex

Limbic

Diencephalon

Brainstem

*The brainstem controls heart rate, body temperature, and other survival-related functions. It also stores anxiety or arousal states associated with a traumatic event. Moving outward towards the neocortex, complexity of functions increases. The limbic system stores emotional information and the neocortex controls abstract thought and cognitive memory.*



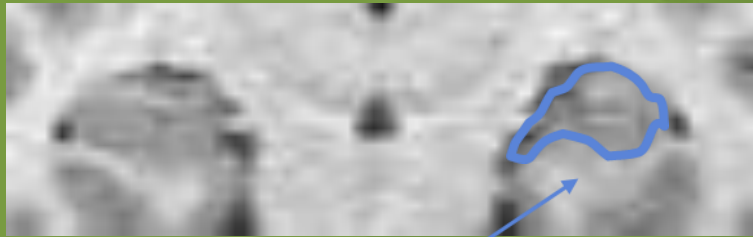
# Hebb's Rule: Neurons that Fire Together Wire Together''

- Brain neurons connect with other neurons or change (chemically and structurally) in response to signals from the environment (experiences) and create memories (cognitive, behavioral, emotional, physical)
- The more often neural connections are made the stronger these connections become
- **Synaptic pruning:** in adolescents, the brain begins to break down the least used connections and strengthens the most used.





# Hippocampal Volume Reduction in PTSD



**NORMAL**



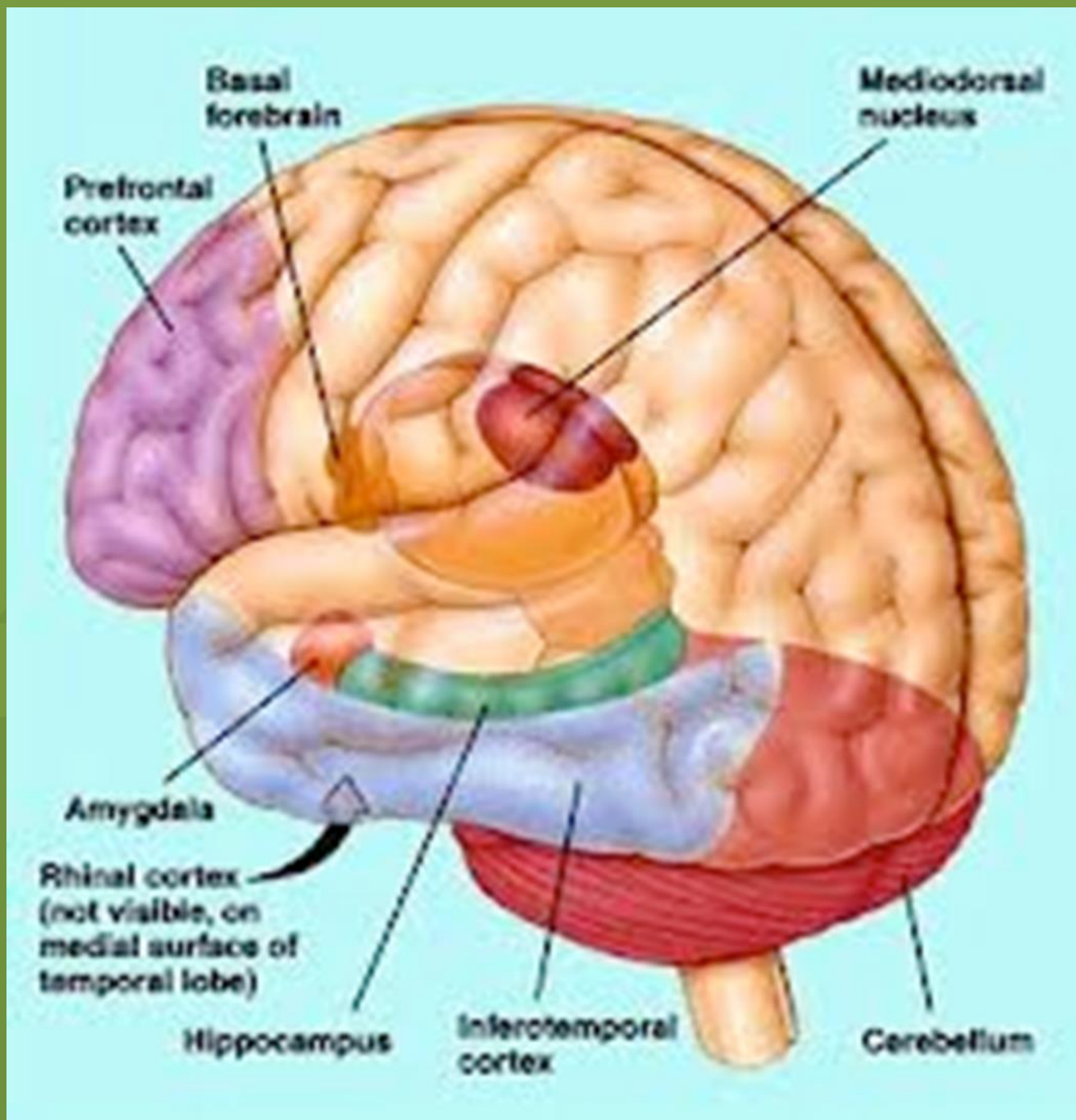
**PTSD**

MRI scan of the hippocampus in a normal control and patient with PTSD secondary to childhood abuse. The hippocampus, outlined in red, is visibly smaller in PTSD. Overall there was a 12% reduction in volume in PTSD.

*Bremner et al., Am. J. Psychiatry 1995; 152:973-981;*

*Bremner et al., Biol. Psychiatry 1997; 41:23-32;*





# The Prefrontal Cortex

- Highly developed in primates and humans
- Allows “executive control” – or at least guidance – over more primitive brain structures
- **Middle region** is critical to relational functioning, empathy, connecting
- Helps us with:
  - Being able to focus
  - Memory and reason
  - Self-awareness, reflection, emotions, impulses



# The Prefrontal Cortex (PFC)



- Connected with the amygdala and exerts inhibitory control over stress responses and emotional reactivity; goals, reason, controls habits
- Prefrontal cortex actually shrinks with PTSD; children/adolescents/young adults don't have developed PFC
- Successful SSRI treatment restored PFC activation patterns



# Fight, Flight, or Freeze

- A lesson from Jakey Cat

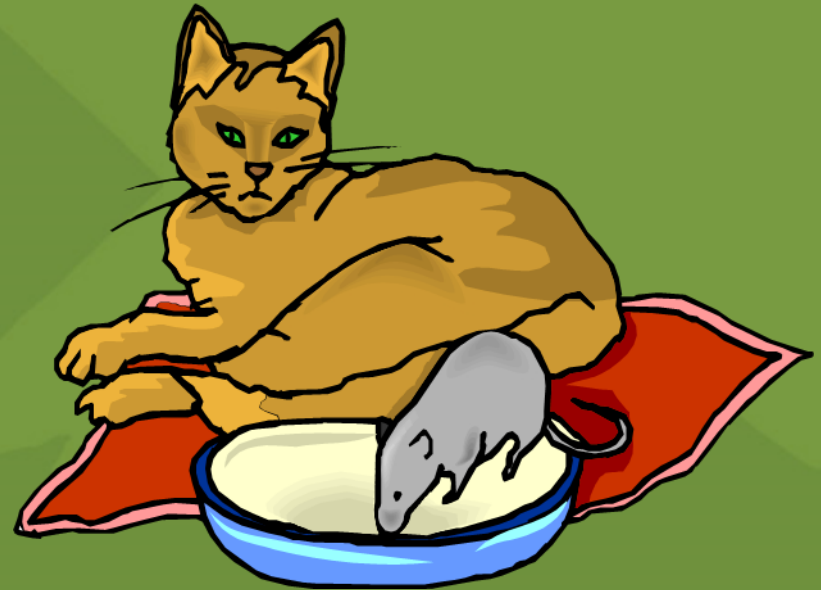


# Jakey Cat (RIP)



# The Freeze Response: Tonic Immobility

- Autonomic Nervous System: sympathetic and parasympathetic nervous system
- Both systems heightened simultaneously under extreme stress
- Tonic immobility as an adaptive survival response; if you move in the animal world – the predator will chase and kill



# If you don't remember anything from this presentation, remember ....

- The more the neural system is activated, the more it will change
- What fires together, wires together
- Trauma leads to dysregulation of the autonomic nervous system and the limbic system; the past is present neurobiologically
- Memory is often impacted by trauma; recall is less explicit, more implicit





# Healing Strategies that Address Neurobiological Issues

- The “helping” relationship (can be therapeutic, first responder, any system response)

"There is no more effective neurobiological intervention than a safe relationship"

-- Bruce Perry



# The Importance of Relationship

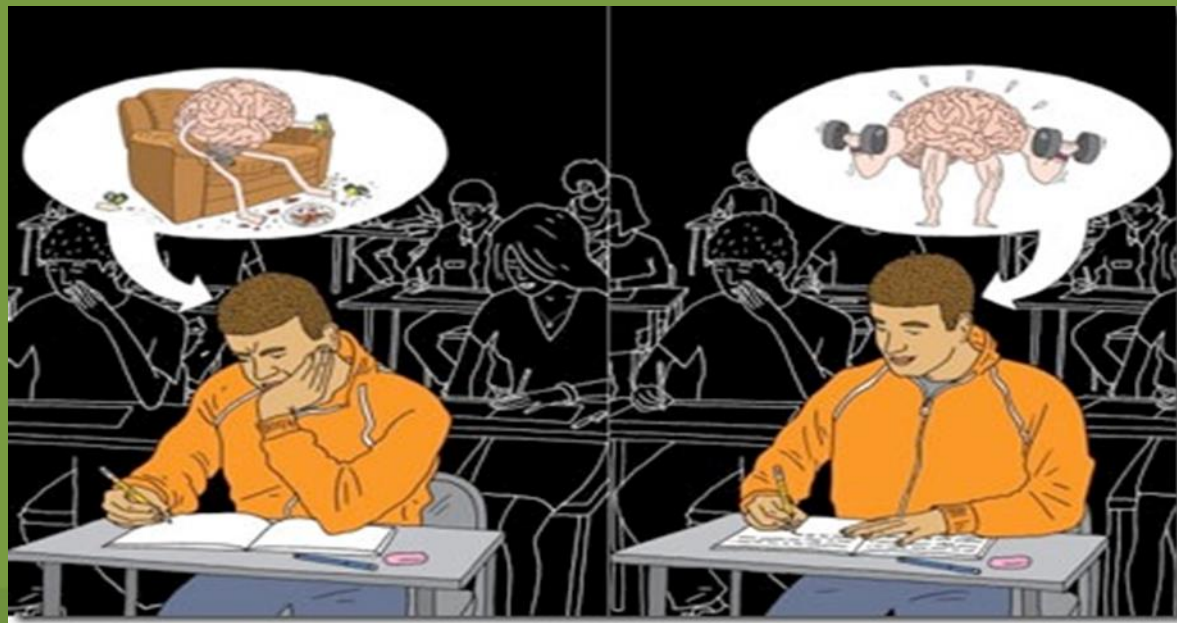
- Oxytocin and vasopressin are linked to bonding and relationships characterized by strong attachments.
- Positive attachments directly rewire the wiring of the orbito-frontal cortex to the Limbic system to mediate emotional response; balance sympathetic and parasympathetic systems



# Importance of Empowerment

- Making decisions develops the cortex
- Involve clients in treatment decisions.
- Avoid using relationships as consequences (e.g., restricting family visits, peer connections)





## Engaging and Exercising the Brain: Neurobics

It is important to challenge the brain to learn new tasks

- Learn new content/skills
- Break routines
- Try new things: switch chores, change foods, new music
- Expose yourself to new environmental stimuli (smells, tastes, changing your visual field)



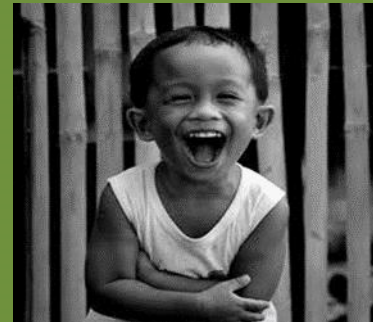
# Patterned, repetitive, rhythmic activity = brainstem regulation

- Walking
- Running
- Dancing
- Singing
- Chanting
- Drumming



# Transforming from the Sympathetic to the Parasympathic System

- The more anxiety we have, the less optimally our brains function
- **Sympathetic System** -
  - Ready to react, on alert, high arousal
- **Parasympathic System** -
  - Relaxed, comfortable, intentional, optimal functioning



# Safe Physical Contact (with humans or animals)

- Touch lowers cortisol, increases limbic bonding
- Massage
- Contact with animals: lowers cholesterol, blood pressure, and triglyceride levels



Scout in Crested Butte, CO



# Meditation/Mindfulness Practice: the power of focused attention



**Study:** Boston-area workers who meditated for 40 minutes a day had significantly thicker cortexes than controls (Lazar et al, 2005)

- Thickens the cerebral cortex (due to trauma, age)
- Increases attention span, sharpens focus, improves memory
- Restores synapses, similar to sleep





# The Power of Yoga to Heal Trauma

- Trauma = Split between mind and body  
Yoga = Unifying mind and body



# Yoga

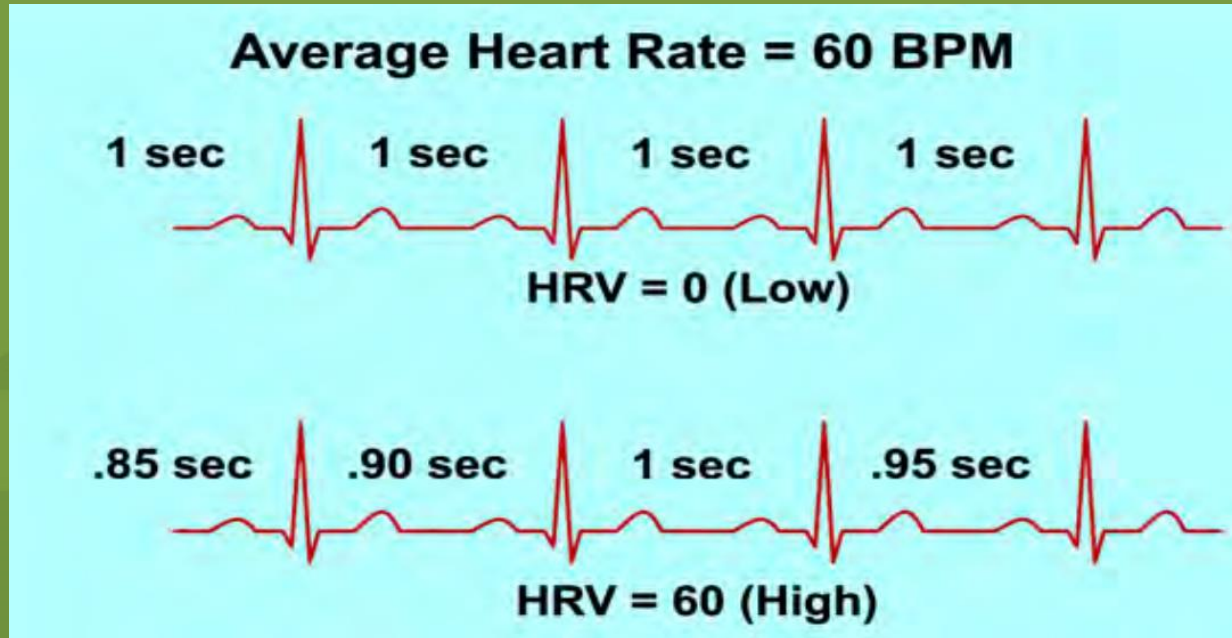
Trauma = split between mind and body

Yoga = unifying mind and body

- Yoga increases heart rate variability (HRV); an indicator of the body's ability to respond more flexibly to stress
- Benefits of controlled breathing activates parasympathetic system similar to those receiving ECT, and taking an antidepressant
- 2010 study from Boston U. School of Medicine; yoga increasing GABA levels (GABA involved in alcohol use)



# Yoga and Heart Rate Variability (HRV)



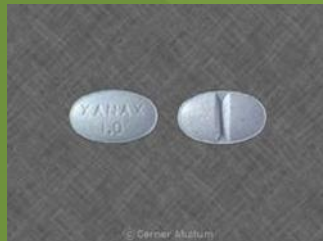
- HRV is the variation in the time interval between one heartbeat and the next. When you inhale, heart rate speeds up; when you exhale it slows down. When HRV is high, a person experience lower levels of stress and great resiliency. Dozens of research studies show that yoga of all kinds (Vinyasa, Hatha, Yoga Nidra) increases HRV.



# The Neurobiology of Yoga



- Yoga increases Gamma-aminobutyric (GABA) levels in the brain (measured by fMRIs)
- Low GABA levels are associated with depression and anxiety
- Activate the GABA receptors with ambien, xanax, or a glass of wine, and you get relaxed and sleepy. When these substances are constantly in the brain and then rapidly withdrawn, you suddenly have overexcited GABA receptors and you can get side effects such as [insomnia](#), anxiety

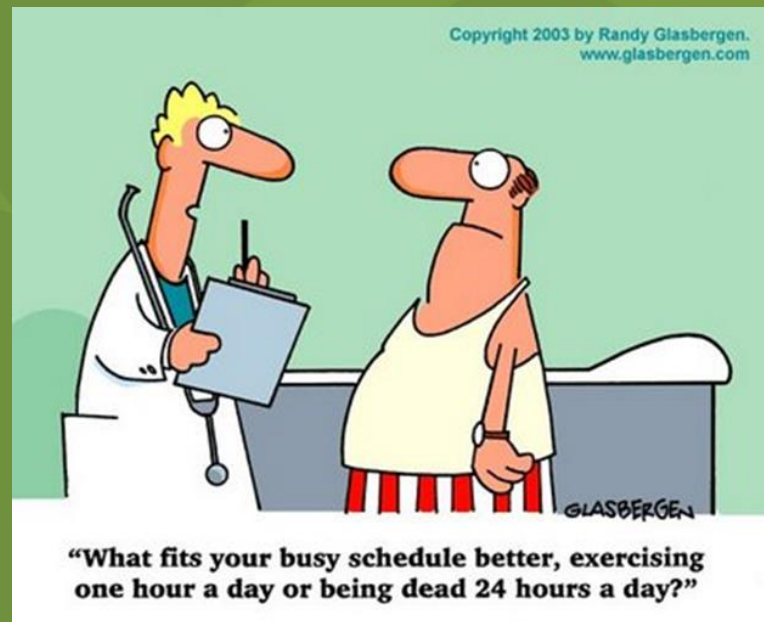


Streeter et al., Effects of Yoga Versus Walking on Mood, Anxiety, and Brain GABA levels: A Randomized Controlled MRS Study. *The Journal of Alternative and Complementary Medicine*, 2010.



# Exercise:

- Rebalances melatonin; enhances sleep cycle
- Releases endorphins (endogenous opioids)
- Promotes tryptophan which enhances mood; precursor to serotonin



What's the worst thing you can do with someone who just experienced or is re-telling the trauma?



# What we can learn from animals who experience trauma











# Sleep, Rest, and Relaxation

- Sleep deprivation keeps nervous system on high-alert; cortisol is elevated
- Serotonin and dopamine rise when sleeping, resting





# Diet



- The brain reads a drop in blood sugar as “danger” and begins to produce adrenaline. Adrenaline can be produced in a split second, leaving one feeling tense, jittery, weak, and dizzy. With someone who suffers from PTSD, these constant drops in blood sugar can cause mood swings into panic, anger or desperation
- Avoid stimulants (sugars, caffeine, non-herbal tea, nicotine, and simple carbohydrates such as white bread, white rice, cakes, cookies, candy bars, soda and ice cream)
- Avoid packaged foods with high sodium – this can turn cortisone into cortisol
- avoid some fruit like bananas, grapefruit, melons, honey, and dates because they are high in sugar content



# Eating to Manage PTSD



- **Foods to Help Decrease Cortisol:**
- **Whole grain** breads and cereals, oat bran, oatmeal, beans, citrus fruits, strawberries, beets and carrots.
- **Vitamin C** – found in foods such as green peppers, citrus fruits, tomatoes, strawberries, broccoli, sweet potatoes and cantaloupe
- **Whey Protein** - The tryptophan found in whey protein increases the levels of [serotonin](#) in the brain and lowers the levels of cortisol in the body. Try a protein shake or combine it with milk, fruit, yogurt and peanut butter for a healthy, low-calorie and cortisol-fighting smoothie.



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