LOVE AND OXYTOCIN

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"Nothing is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less."

Marie Curie

www.deism.com

2

PURPOSE: TO EXPLORE THE EVOLUTION AND BIOLOGY OF LOVE, FEAR AND OXYTOCIN - A COMPARATIVELY MODERN HORMONE THAT WHAT MAKES US "HUMAN"

Human existence required THE EVOLUTION OF A SOCIAL SOLUTION for dealing with Stress and Trauma in a complex world. The evolution of -

1. OXYTOCIN
2. SOCIALITY, and especially
3. SELECTIVE SOCIAL BONDS and ATTACHMENTS
4. SOCIOSTASIS

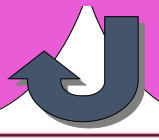
HIGH LEVELS OF SOCIALITY and DEPENDENCE ON OTHERS is central to being HUMAN. The biology that we experience today as FEAR and LOVE originated over 500 million years ago as a way of dealing with the stress of life on Earth.

3

SOCIOSTASIS

The Mammalian Nervous System is adapted to use "OTHERS" to regulate all aspects of biology including emotions and behavior.
This is especially true in humans in early life.

CONNECTIONS and ATTACHMENTS are necessary for physiological and behavioral homeostasis.



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In the ABSENCE of LOVE and a SENSE OF SAFETY
-
The OXYTOCIN-VASOPRESSIN PATHWAYS
&
AUTONOMIC SYSTEMS BECOME DYSREGULATED -
LESS PROTECTIVE

VULNERABILITY to Mental and Physical Dysfunction

5

CONTEXT FOR UNDERSTANDING LOVE AND OXYTOCIN - THE WORLD HAS ALWAYS HELD DANGER AND TRAUMA.

The Wave Off Kanagawa. By Hokusai 1829-1833

6

CONTEXT: Survival is the first law of nature.
It is biologically important that we are not alone.

At the Edge of the Desert by Robert Bissell

7

CONTEXT: Sociality and Love have survival benefits. There is safety in numbers.

The Lookouts by Robert Bissell

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ACUTE FEAR IS ADAPTIVE AND CAN BE PROTECTIVE

Love may overcome fear –

But HOW DOES THIS HAPPEN?

9

FEAR, ANXIETY AND PAIN ARE PRIMITIVE AND ADAPTIVE. BUT OVER REACTION TO CHRONIC TREAT IS MALADAPTIVE. FEAR CAN CAUSE DISEASE. LOVE CAN HEAL.

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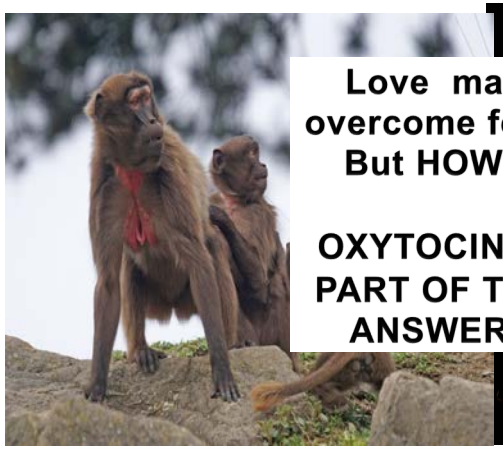
CONTEXT:
LOVE and FEAR both have survival benefits.



Love may overcome fear, But HOW?

OXYTOCIN IS PART OF THE ANSWER.

11

Oxytocin - mediating cues of "safety" – helps to explain the evolutionary biology and benefits of social support and co-regulation.

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What is love?

LOVE is usually defined by ATTACHMENTS AND SOCIAL BONDS AND A NEED TO PROTECT THOSE THAT WE LOVE.

Here I define LOVE as a complex of neurobiological processes that facilitates health, wellness, reproductive fitness & biological optimality.

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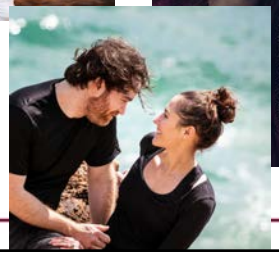
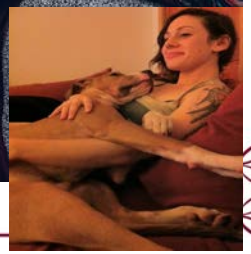
LOVING RELATIONSHIPS CAN COME IN MANY FORMS



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What does SCIENCE teach us?
The BIOLOGICAL AND EVOLUTIONARY prototype for LOVE is the PARENT-CHILD INTERACTION.

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The biology of both love and good health are based on the biology of MAMMALIAN REPRODUCTION

16

Social bonds and a sense of SAFETY first appear In association with birth and breast-feeding (lactation)

17

The EVOLUTIONARY & BIOCHEMICAL prototype for LOVE and social bonds in mammals is the mother-child interaction including BIRTH & LACTATION

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The protective effects of positive early life experiences and attachment depend in part on hormones including OXYTOCIN.

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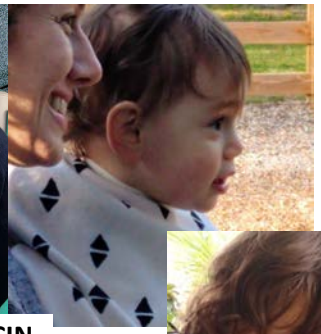

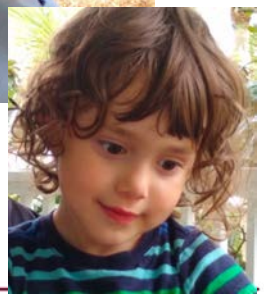

HORMONES INCLUDING OXYTOCIN FACILITATE BIRTH, LACTATION & BUFFER NEW PARENTS (FATHERS AND MOTHERS) FROM THE STRESS OF CHILD REARING.

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THE REWARD FOR PREGNANCY AND THE PAIN OF CHILD BIRTH.

THE MOST ATTRACTIVE OBJECT IN THE WORLD.

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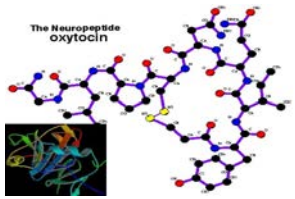
WHAT IS OXYTOCIN?

Oxytocin is a NEUROPEPTIDE MOLECULE with functions throughout the BRAIN and BODY.

OXYTOCIN is central to the biology of SAFETY & LOVE.



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WHAT IS OXYTOCIN?

Cys-Tyr-Ile-Gln-Asn-Cys-Pro-Leu-Gly-NH_2

9 amino acids configured as a ring and a tail.

The ring in oxytocin is held together by sulfur bonds. These bonds allow oxytocin to have a high degree of biological activity and facilitating positive social behaviors, stress buffering and good health. OXYTOCIN also supports SOCIAL BONDS and LOVE.

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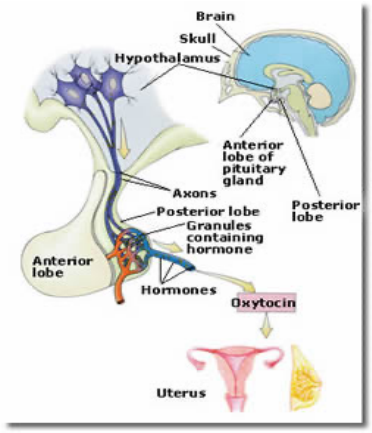
What is oxytocin

Oxytocin was classically viewed as a "FEMALE REPRODUCTIVE HORMONE," acting primarily on the UTERUS and MAMMARY GLAND.

Of course, we now know that this is only part of the story!

OXYTOCIN HAS EFFECTS IN BOTH MALES & FEMALES THROUGHOUT THE BODY & BRAIN



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Oxytocin supports or permits:

PREGNANCY
INFANT NUTRITION
MATERNAL BEHAVIOR
PATERNAL BEHAVIOR
ALLOPARENTAL BEHAVIOR
and
EXTENDED NURTURE
of the
immature
human offspring
And

ATTACHMENT and LOVE

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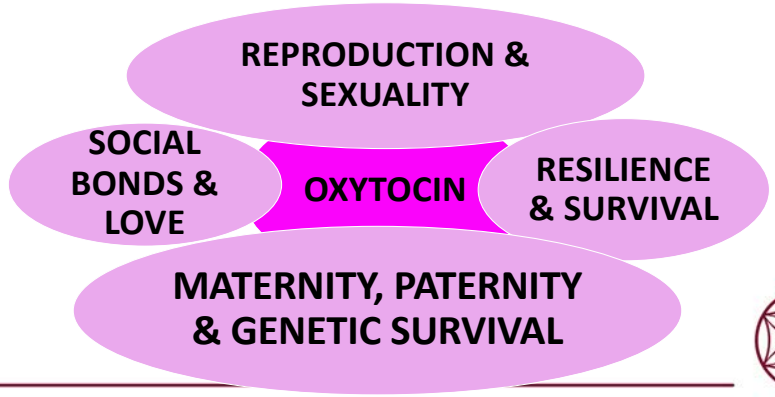
Overview: OXYTOCIN PATHWAYS, CRITICAL TO A SENSE OF SAFETY, UNDERLIE CENTRAL FEATURES OF SOCIAL BEHAVIOR ASSOCIATED WITH MAMMALIAN REPRODUCTION AND SURVIVAL



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Many functional parallels exist between LOVE and OXYTOCIN (detailed in Carter, 2022, cPNEC)

FUNCTIONS (among many)	LOVE	OXYTOCIN
MODERN (evolutionarily recent)	+	+
Associated with SELECTIVE sociality & bonds	+	+
Supporting parental investment	+	+
Metaphor for SAFETY	+	+
Selectively rewarding	+	+
Anti-inflammatory/Anti-oxidant	+	+
Anxiolytic/Analgesic	+	+
Allows immobilization without fear	+	+
Sexually dimorphic	+	+
Epigenetically tuned and Context dependent	+	+

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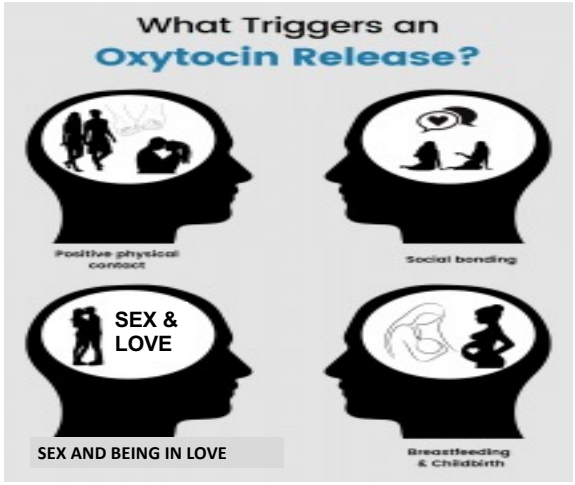

As well as ACUTE FEAR, INTENSE EXERCISE and MORE – but

All of these can have complex effects…

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Oxytocin does NOT act alone.

OXYTOCIN (OT) has a sibling hormone –
Arginine VASOPRESSIN (AVP) –
from which it differs by 2 (of 9) amino acids

OXYTOCIN (OT)

Cys-Tyr-Ile-Gln-Asn-Cys-Pro-Leu-Gly-NH_2

Arginine VASOPRESSIN (AVP)

Cys-Tyr-Phe-Gln-Asn-Cys-Pro-Arg-Gly-NH_2

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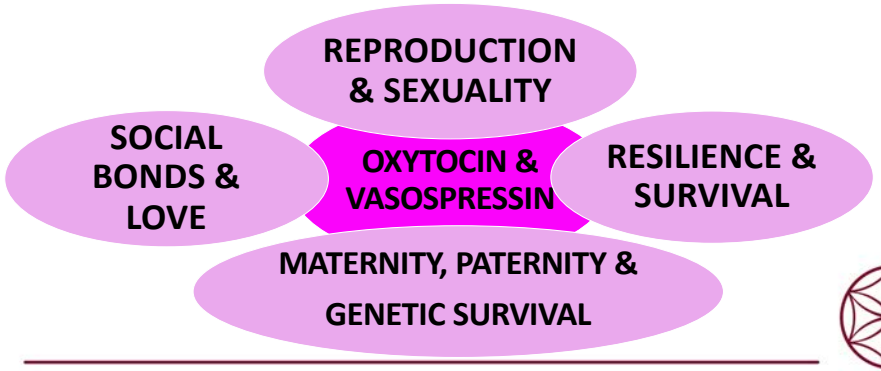
OXYTOCIN PLUS VASOPRESSIN BOTH UNDERLIE CENTRAL FEATURES OF SOCIAL BEHAVIOR ASSOCIATED WITH MAMMALIAN REPRODUCTION AND SURVIVAL



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SMALL STRUCTURAL DIFFERENCES IN OXYTOCIN AND VASOPRESSIN ALLOW THEM TO INTERACT WITH EACH OTHERS' RECEPTORS.

STIMULATING OXYTOCIN RECEPTORS IS ASSOCIATED WITH PROSOCIALITY.

STIMULATING VASOPRESSIN RECEPTORS IS ASSOCIATED WITH DEFENSE.. But

THESE MOLECULES MAY STIMULATE EACH OTHERS' RECEPTORS.

THEY MAY INHIBIT THE ACTIONS OF EACH OTHER.

THEY CAN HAVE DIFFERENT EFFECTS IN DIFFERENT CONTEXTS AND DIFFERENT BRAIN REGIONS, DEPENDING ON THE HISTORY OF THE INDIVIDUAL.

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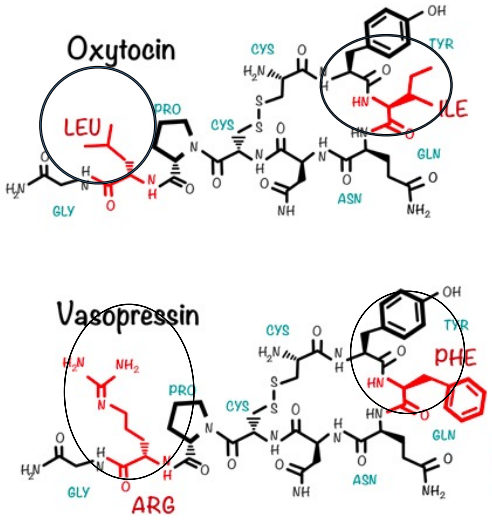
THIS ALLOWS MANY VARIATIONS OF ACTION FROM JUST TWO MOLECULES, AND SUPPORTS THE COMPLEXITY OF MAMMALIAN SURVIVAL AND REPRODUCTION.



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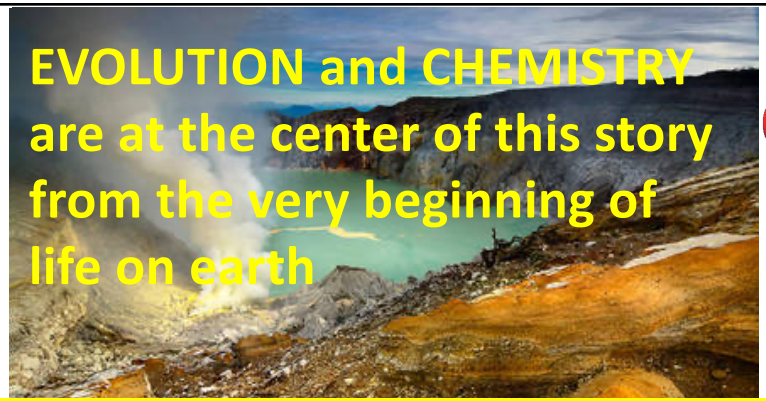

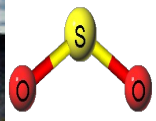

SULFUR DIOXIDE

LIFE ON EARTH, INCLUDING NUCLEOTIDES (RNA & DNA AND EVENTUALLY AMINO ACIDS/PROTEINS), ARE BELIEVED TO HAVE ORIGINATED IN AN ANCIENT MOLTEN CALDRON CONTAINING OXYGEN AND SULFUR

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EARLY EARTH WAS A HARSH ENVIRONMENT. MANY CHALLENGES HAD TO BE OVERCOME TO ALLOW LIFE TO EVOLVE.
SIMPLE ELEMENTS AND LATER COMPLEX BIOLOGICAL MOLECULES ALSO CONTAINING CHEMICAL BONDS ARE AT THE HEART OF THE EVOLUTION OF LIFE, SOCIOSTASIS EVENTUALLY LOVE.
This took at least 500 million years.

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THE EVOLUTION OF A MODERN SOLUTION TO THE "STRESS OF LIFE"

Time	***EVOLUTION of :***	***CHEMICALS:***
PRESENT		
7 mya to 300,000	Human Ancestors	
150 - 100 mya	Mammals	**Oxytocin (anti-inflammatory)**
250 - 200 mya	Modern Vertebrates	**Vasopressin (pro-inflammatory)**
<542 - 485 mya	Many new species	**CRF (pro-inflammatory)**
Approx. 541 mya	***The Cambrian explosion begins - Oxygen levels increase supporting terrestrial life***	
>4 bya – 541 mya	Metazoan (Multicell.) (rudimentary HPA axis)	CRF-like, VT-like, steroid molecules *managing water, minerals, energy, inflammation*
Pre-Cambrian	Unicellular Eukaryota Prokaryota	Amino acids, Nucleotides (RNA-DNA,) Vasotocin (VT), Steroids, Neuropeptides, Neurotransmitters, Cytokines, Receptors (GCPR, Ion Channels)
>4.5 bya	Formation of Earth	Basic elements (incl. H, C, N, O, S, minerals)
>14 bya (*Big Bang*)`	Formation of Universe	Particles and matter

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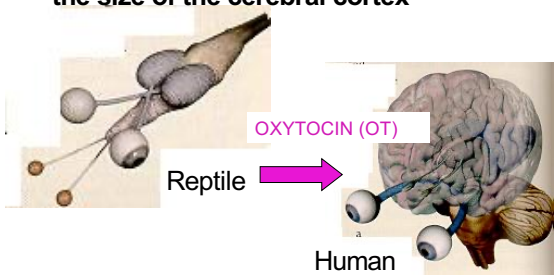
The human nervous system is a consequence of evolution. Compared to reptiles humans have a massive increase in the size of the cerebral cortex



OXYTOCIN (OT) allowed the transition from reptile to mammal.

OT permits birth (helps expel the large-brained baby from the uterus)

OT facilitates post-birth nutrition & supports the baby (lactation/maternal behavior/alloparenting)

OT facilitates oxygenation of the brain (myelinated vagus).

OT PERMITS HUMAN COGNITION AND SOCIAL BEHAVIOR.

WE ARE HERE TODAY BECAUSE OF OXYTOCIN!

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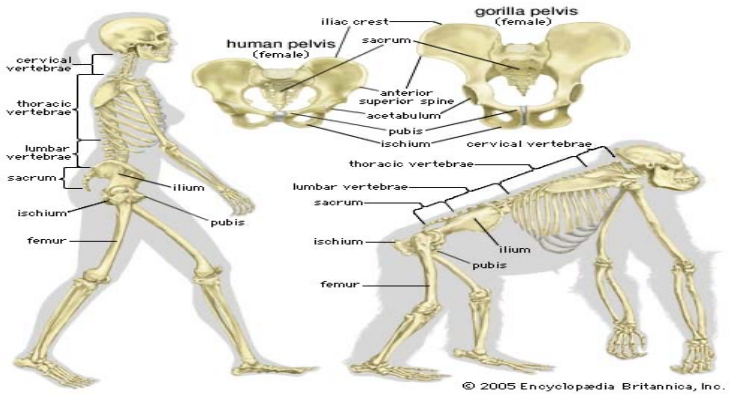

HUMAN BIRTH presents special problems because of our

- **BIG CORTEX and SKULL,**
- **BIPEDAL LOCOMOTION and**
- **SMALL, RIGID PELVIC GIRDLE**

OXYTOCIN FACITATES BIRTH by STRONG UTERINE CONTRACTIONS

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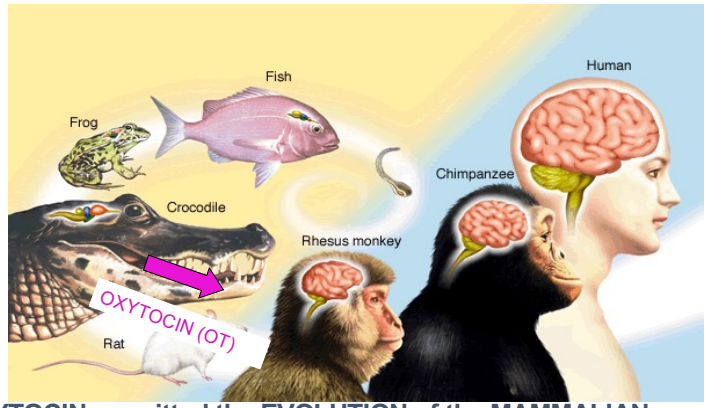

OXYTOCIN permitted the EVOLUTION of the MAMMALIAN NERVOUS SYSTEM and eventually the EVOLUTION of the HUMAN NERVOUS SYSTEM and the COGNITIVE EXPERIENCES WE CALL "LOVE" AND ATTACHMENT

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The protective effects of positive early life experiences and attachment depend in part on oxytocin.

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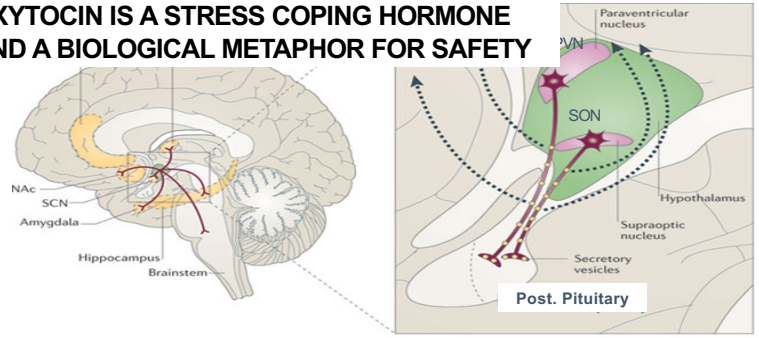
OXYTOCIN IS A STRESS COPING HORMONE AND A BIOLOGICAL METAPHOR FOR SAFETY



Oxytocin is made primarily in the BRAIN (HYPOTHALAMUS), and released into the blood stream at the Posterior Pituitary, but is also released within the nervous system.

Oxytocin can affect social behavior, the autonomic nervous system, and the immune system, allowing the body to ADAPT, PROTECT and HEAL especially in the face of challenge, STRESS and INFLAMMATION.

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The EVOLUTION OF SOCIALITY AND LOVE involves: A dynamic dance between Oxytocin and Vasopressin

Oxytocin facilitates a sense of SAFETY & SYNCHRONY, as well as the capacity to RELAX AND RESTORE.

Vasopressin permits ACTIVE DEFENSE and MOBILIZATION.

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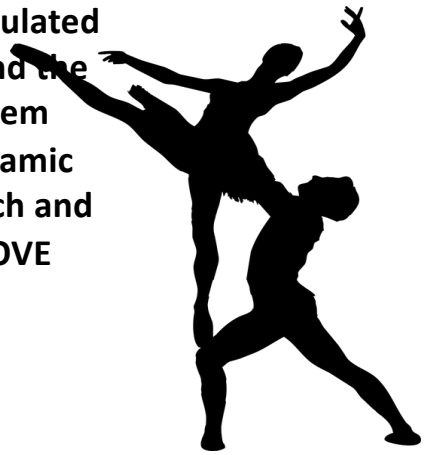
Physiological states, regulated by ancient hormones and the autonomic nervous system are elements in the dynamic dance between approach and avoidance – between LOVE and FEAR



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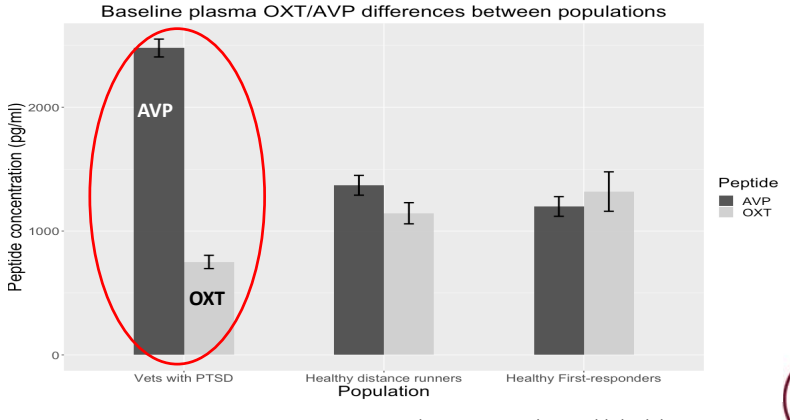
PTSD patients (vets mostly male) had LOW OXYTOCIN AND HIGH VASOPRESSIN

Non-patients (first responders in SWAT training) or
Healthy runners doing an Ultramarathon did not show this pattern, even under extreme acute stress.



Horn, Nazarloo, Carter, et al., unpublished data 2021

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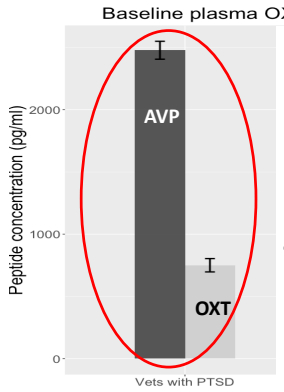

SOCIAL SUPPORT, IN PART THROUGH THE EFFECTS OF OXYTOCIN, MAY PROTECT AND HEAL TRAUMA.

IT IS LIKELY THAT INDIVIDUALS WITH A TRAUMA HISTORY, INCLUDING PTSD, HAVE LESS ACCESS TO THE BENEFITS OF OXYTOCIN (OXT)

Horn, Nazarloo, Carter, et al., unpublished data 2021

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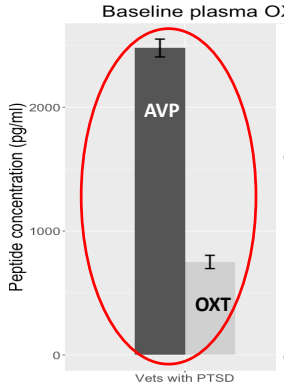
INFLAMMATION MAY PLAY A ROLE IN THE SYMPTOMS OF PTSD



SOCIAL SUPPORT VIA ANTI-INFLAMMATORY EFFECTS, INCLUDING OXYTOCIN MAY PROTECT AND HEAL TRAUMA.

IT IS LIKELY THAT INDIVIDUALS WITH PTSD ARE EXPERIENCING EXCESSIVE INFLAMMATION, WITH LESS ACCESS TO THE BENEFITS OF OXYTOCIN (OXT) AND MORE EXPOSURE TO VASOPRESSIN (AVP)

Horn, Nazarloo, Carter, et al., unpublished data 2021

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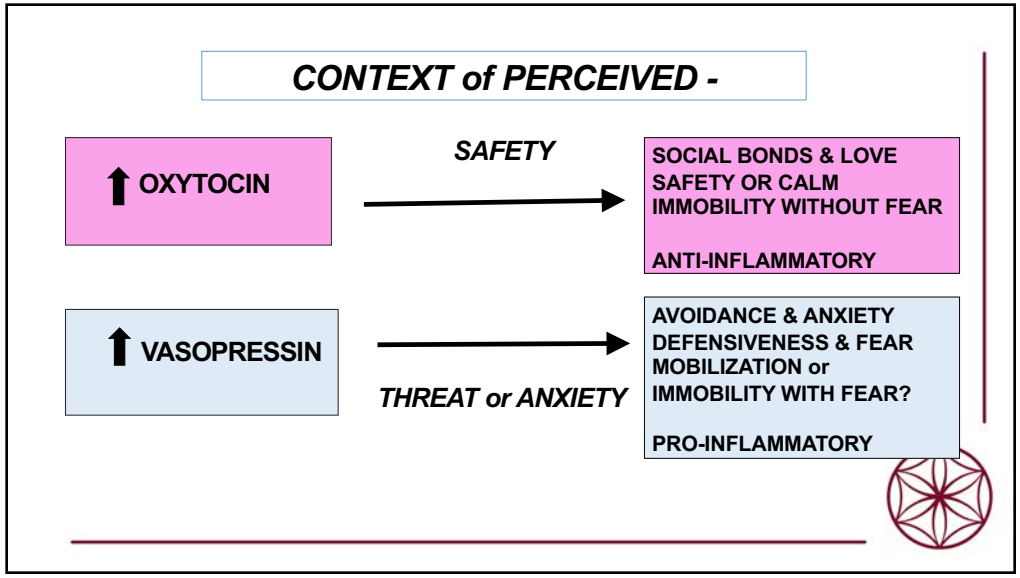
CONTEXT of PERCEIVED -
OXYTOCIN
SAFETY
SOCIAL BONDS & LOVE
SAFETY OR CALM
IMMOBILITY WITHOUT FEAR
ANTI-INFLAMMATORY
VASOPRESSIN
THREAT or ANXIETY
AVOIDANCE & ANXIETY
DEFENSIVENESS & FEAR
MOBILIZATION or
IMMOBILITY WITH FEAR?
PRO-INFLAMMATORY

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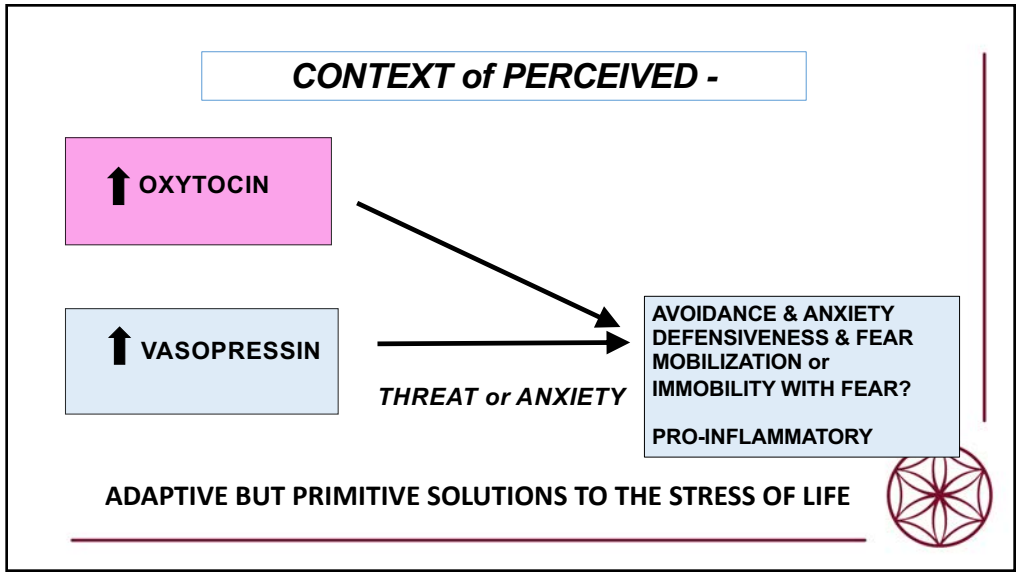
CONTEXT of PERCEIVED -
OXYTOCIN
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THREAT or ANXIETY
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MOBILIZATION or
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PRO-INFLAMMATORY
ADAPTIVE BUT PRIMITIVE SOLUTIONS TO THE STRESS OF LIFE

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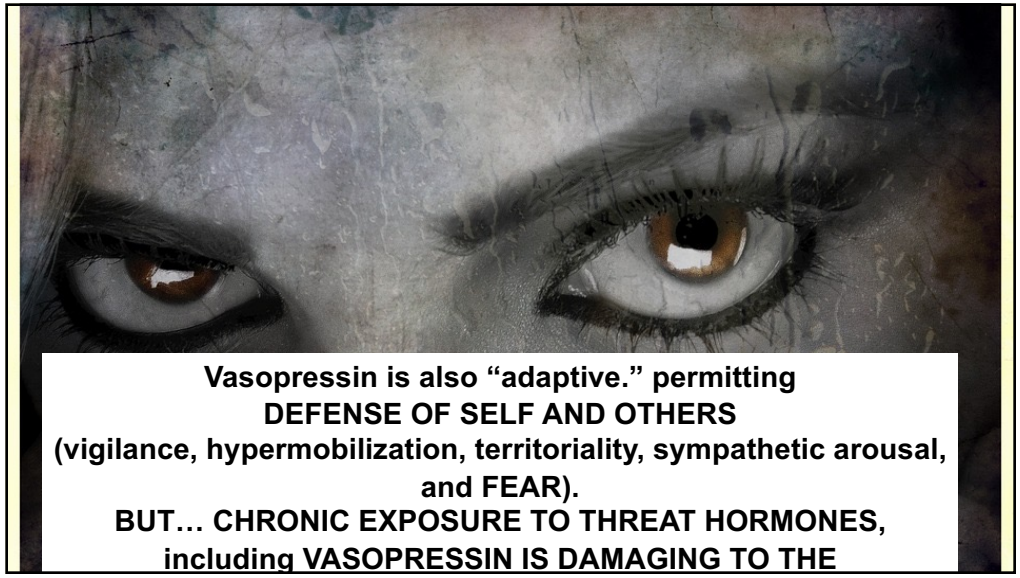

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Vasopressin (AVP) and
hormones of the stress axis (HPA AXIS including CRF)
are primarily pro-inflammatory - fast strategies of defense.

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Oxytocin works like a fire extinguisher…
Acting as an anti-inflammatory and anti-oxidant.

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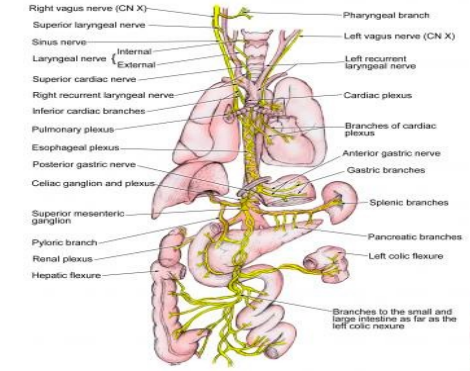
Of particular importance to understanding Oxytocin & Vasopressin - as well as the HEALING POWER OF LOVE - is the fact that these hormones act on the AUTONOMIC NERVOUS SYSTEM and regulate the VAGUS NERVE

THE VAGUS (10TH CRANIAL NERVE), SHOWN HERE, LINKS THE BODY TO THE BRAIN, AND IS CRITICAL TO EXPLAINING THE HEALTH BENEFITS OF FEELING SAFE AND THE HEALTH RISKS OF FEAR AND ANXIETY.

OXYTOCIN & VASOPRESSIN BOTH REGULATE THE ADAPTIVE FUNCTIONS OF THE AUTONOMIC NERVOUS SYSTEM AS WELL AS REGULATING INFLAMMATION AND HEALING.



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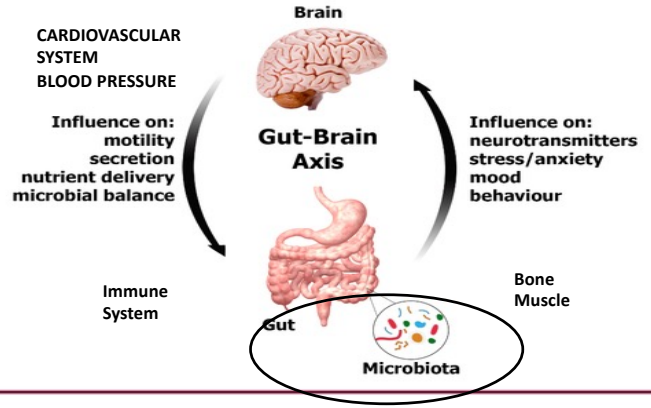
Oxytocin receptors are in the brain, digestive system, immune system, bone and muscle. Oxytocin is needed for the optimal beneficial effects of probiotic bacteria (microbiota) and to balance inflammation.



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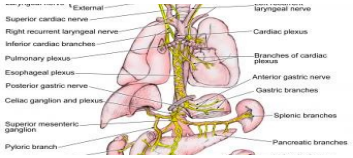
DISORDERS LINKED TO OXYTOCIN DEFICIENCY OR DYSFUNCTION (or ATYPICAL/EXCESS VASOPRESSIN) (MOST – PERHAPS ALL OF THESE ARE ASSOCIATED WITH EXCESS INFLAMMATION)

MENTAL HEALTH

- Social & Emotional Dysfunctio
- Autism Spectrum Disorders
- Schizophrenia
- Anxiety
- Depression (general)
- Postpartum depression
- Trauma
- Prader-Willi Syndrome
- Fragile X
- Substance Abuse
- Williams Syndrome (hi PEPTIDES)

LINKED BY

VAGUS/AUTONOMICS and OXYTOCIN – VASOPRESSIN AN INTEGRATED SYSTEM



PHYSICAL HEALTH

- Stress management
- Cardiovascular Devel. & Disease
- Obesity & Metabolism
- Wound Healing
- Bone Health (Osteoporosis)
- Muscle Strength (Myopenia)
- Chronic Pain
- Fibromyalgia
- Immune dysfunction (HIV?)
- Longevity

INFLAMMATION

OXYTOCIN IS ANTI-INFLAMMATORY

VASOPRESSIN PREDOMINANTLY PRO-INFLAMMATORY

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SOCIOSTASIS

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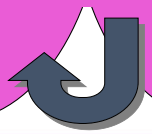
This is especially true in humans in early life.

CONNECTIONS and ATTACHMENTS are necessary for physiological and behavioral homeostasis.



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In the ABSENCE of LOVE and a SENSE OF SAFETY

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The OXYTOCIN-VASOPRESSIN PATHWAYS & AUTONOMIC SYSTEMS BECOME DYSREGULATED - LESS PROTECTIVE

VULNERABILITY to Mental and Physical Dysfunction

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The protective effects of positive early life experiences and attachment depend in part on oxytocin.

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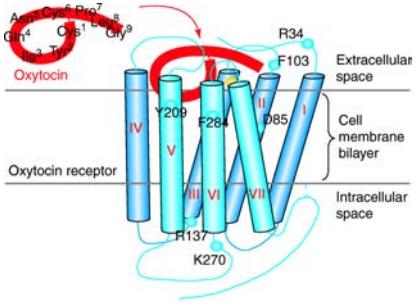
THE OXYTOCIN SYSTEM CAN BE TUNED BY EARLY NURTURE, INCREASING RESILIENCE ACROSS THE LIFE SPAN



The OXYTOCIN RECEPTOR is "EPIGENETICALLY TUNED" Especially by EARLY LIFE EXPERIENCES, and is generally UPREGULATED by POSITIVE EXPERIENCES.

From: Zingg and Laporte . *TRENDS in Endocrinology and Metabolism (2003)* 14(5): 222-227

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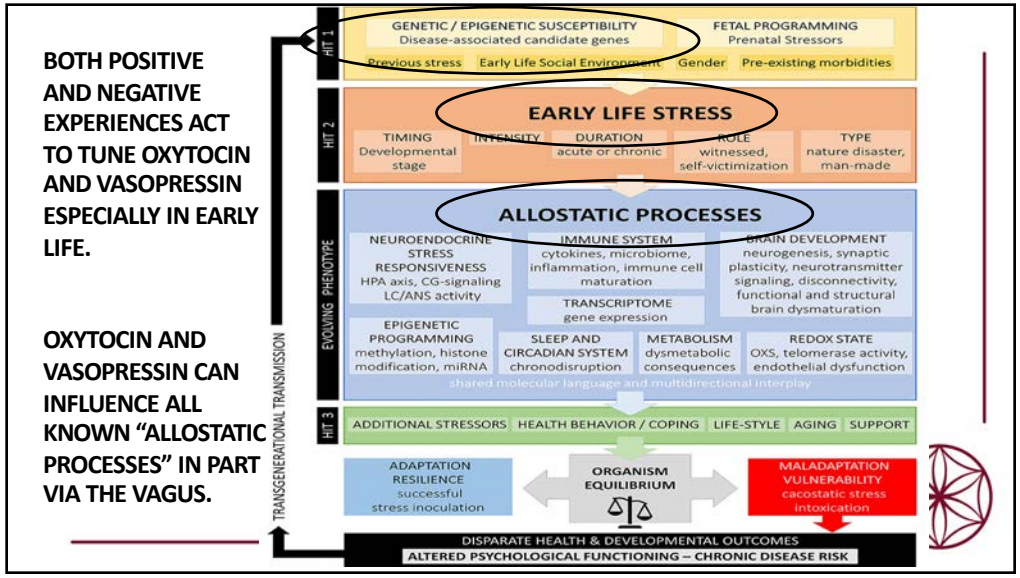
BOTH POSITIVE AND NEGATIVE EXPERIENCES ACT TO TUNE OXYTOCIN AND VASOPRESSIN ESPECIALLY IN EARLY LIFE.

OXYTOCIN AND VASOPRESSIN CAN INFLUENCE ALL KNOWN "ALLOSTATIC PROCESSES" IN PART VIA THE VAGUS.



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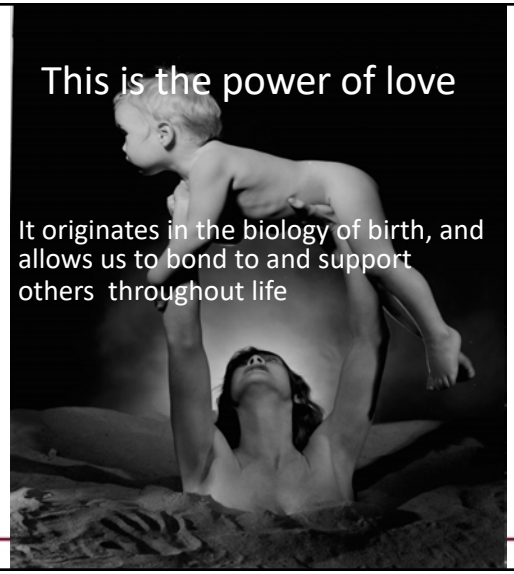

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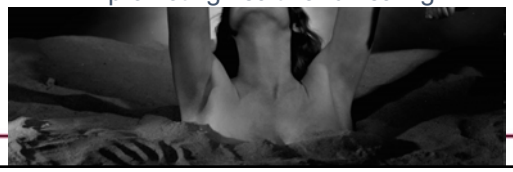
"The soul is healed by being with children."
F. Dostoyevsky

It is critical that we support and love the next generation - our children and each other –
promoting health and healing.



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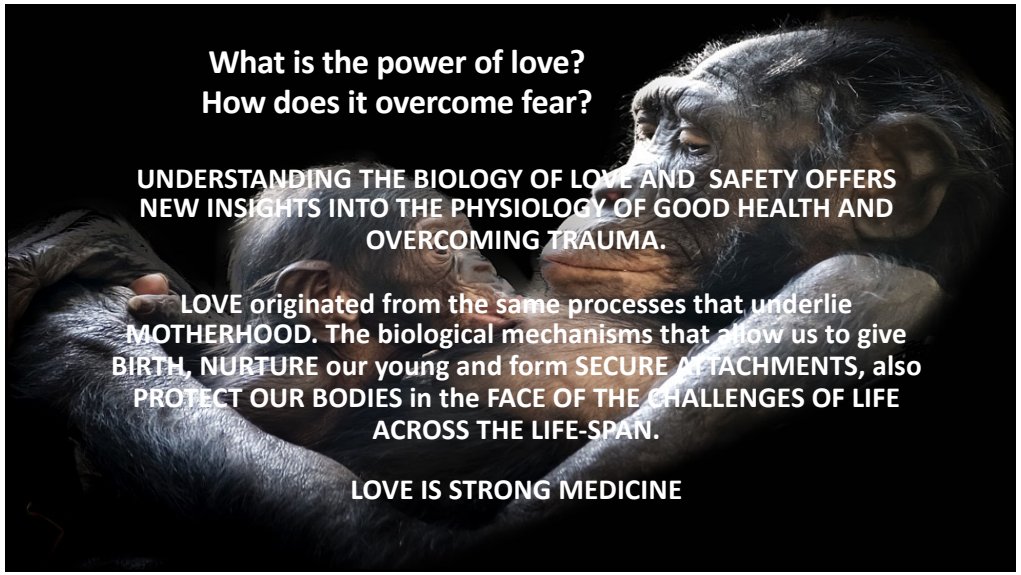

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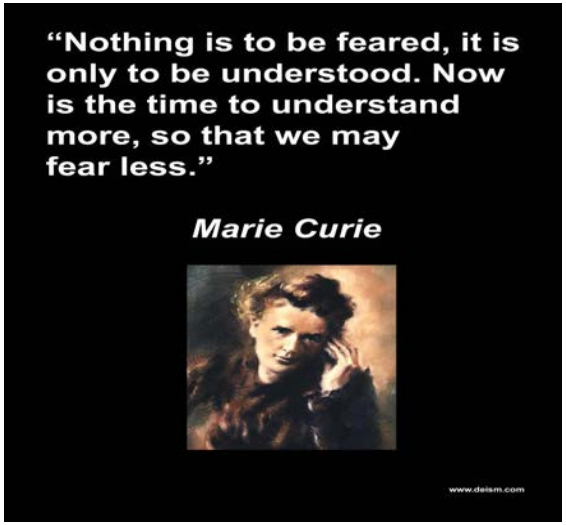
"Nothing is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less."
Marie Curie
www.deism.com

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