INSTITUTO EUROPEO DE SALUD MENTAL PERINATAL

Formación en
Lactancia y Salud Mental

Psicología de la Lactancia

Dirigida por Ibone Olza,
Carmela Baeza y Esther R. Matos

Información e inscripciones
saludmentalperinatal.es

Instituto Europeo de
Salud Mental Perinatal

Introducing NURTURESCIENCE a new model with ancient roots.

Dr Nils Bergman

MB ChB, DCH, MPH, MD

(USA equiv: MD, MPH ,PhD)

Karolinska Institute, Sweden.

Introducing NURTURESCIENCE a new model with ancient roots.

NINO

Nurturescience
for Improved
Neonatal Outcomes

www.ninobirth.org

Introducing NURTURESCIENCE a new model with ancient roots.

Instituto Europeo de
Salud Mental Perinatal

… with focus on long term mental health benefits.

Introducing NURTURESCIENCE a new model with ancient roots.

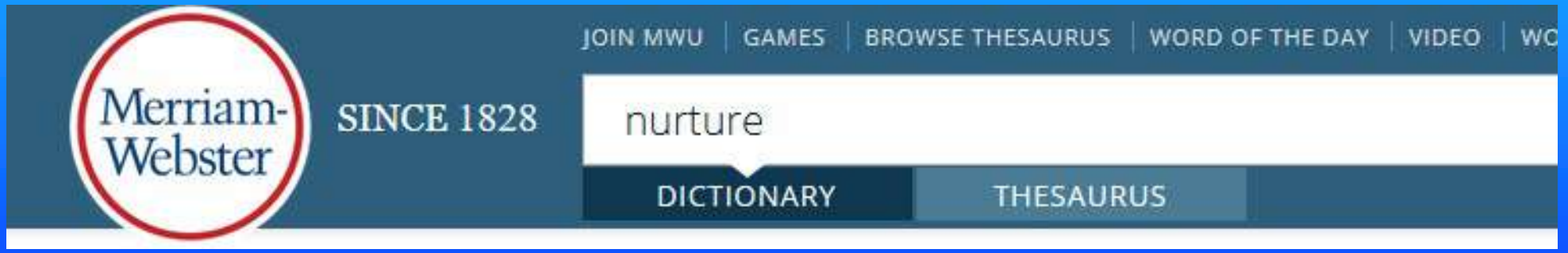
nurture noun

nur·ture | \ ˈnər-chər \

Definition of *nurture* (Entry 1 of 2)

1 : TRAINING, UPBRINGING

// With proper focus during early *nurture*, one can grow into a secure being ...



Introducing NURTURESCIENCE a new model with ancient roots.

nurture noun

nur·ture | \ ˈnər-chər \

Definition of *nurture* (Entry 1 of 2)

1 : TRAINING, UPBRINGING

// With proper focus during early *nurture*, one can grow into a secure being ...
— Ella Pearson Mitchell

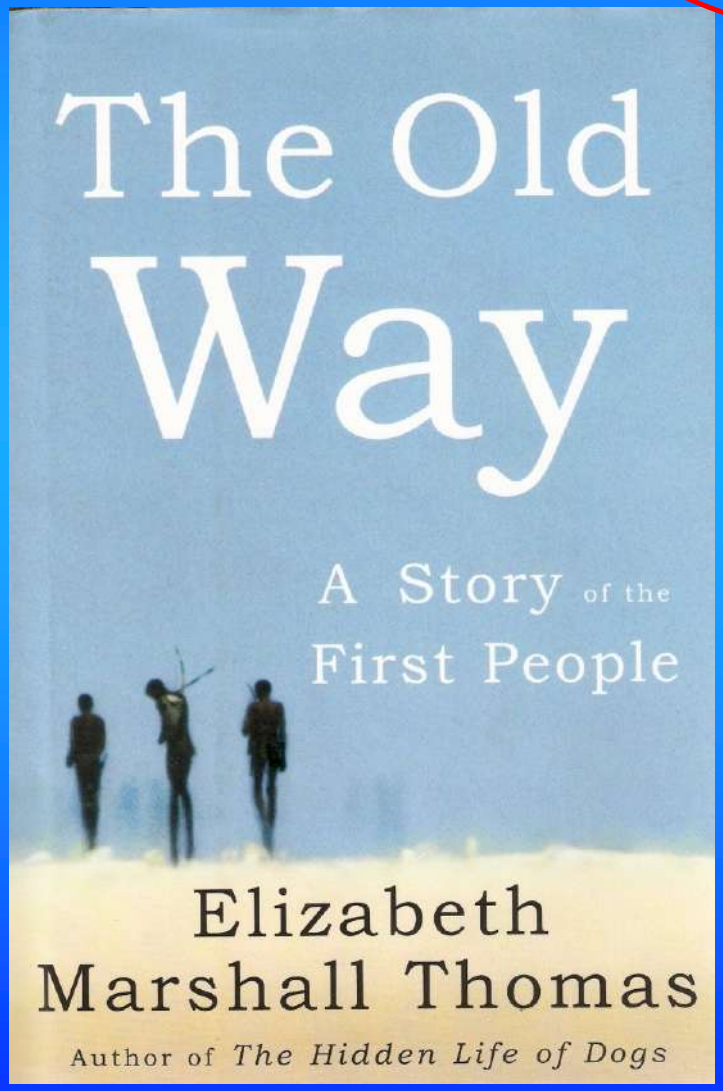
2 : something that nourishes : FOOD

// ... fed him well, and nourished himself, and took *nurture* for the road ...
— R. D. Blackmore

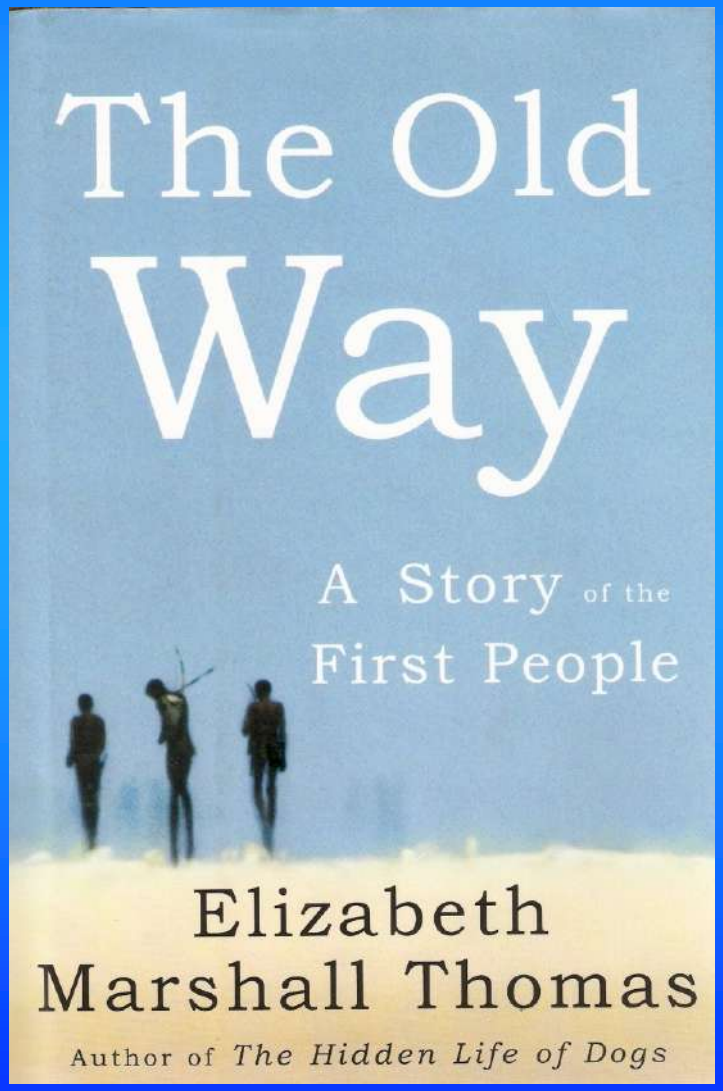
3 : the sum of the environmental factors influencing the behavior and traits expressed by an organism

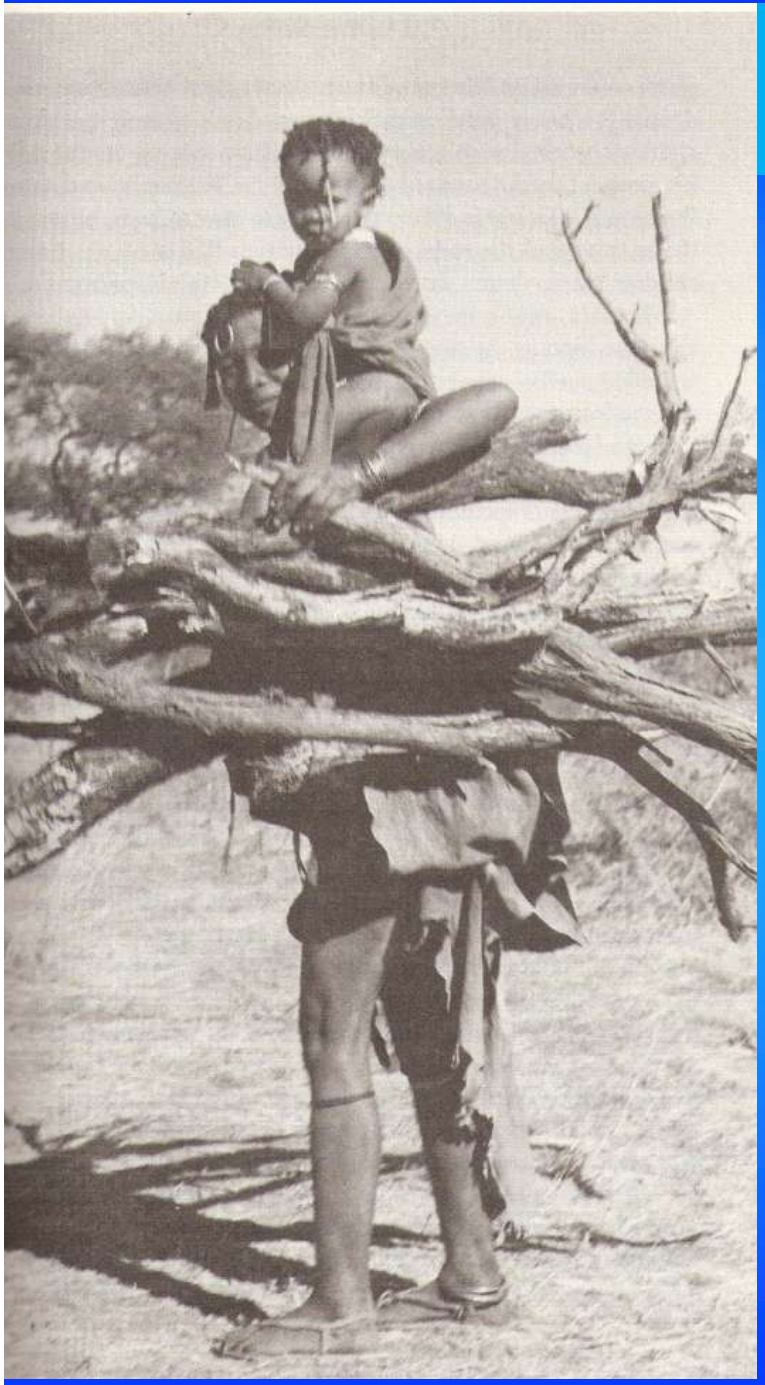
// Is our character affected more by nature or by *nurture*?

Introducing NURTURESCIENCE a new model with ancient roots.



Other Ways of Being Born and Growing


The Old Way
A Story of the First People
Elizabeth Marshall Thomas
Author of The Hidden Life of Dogs



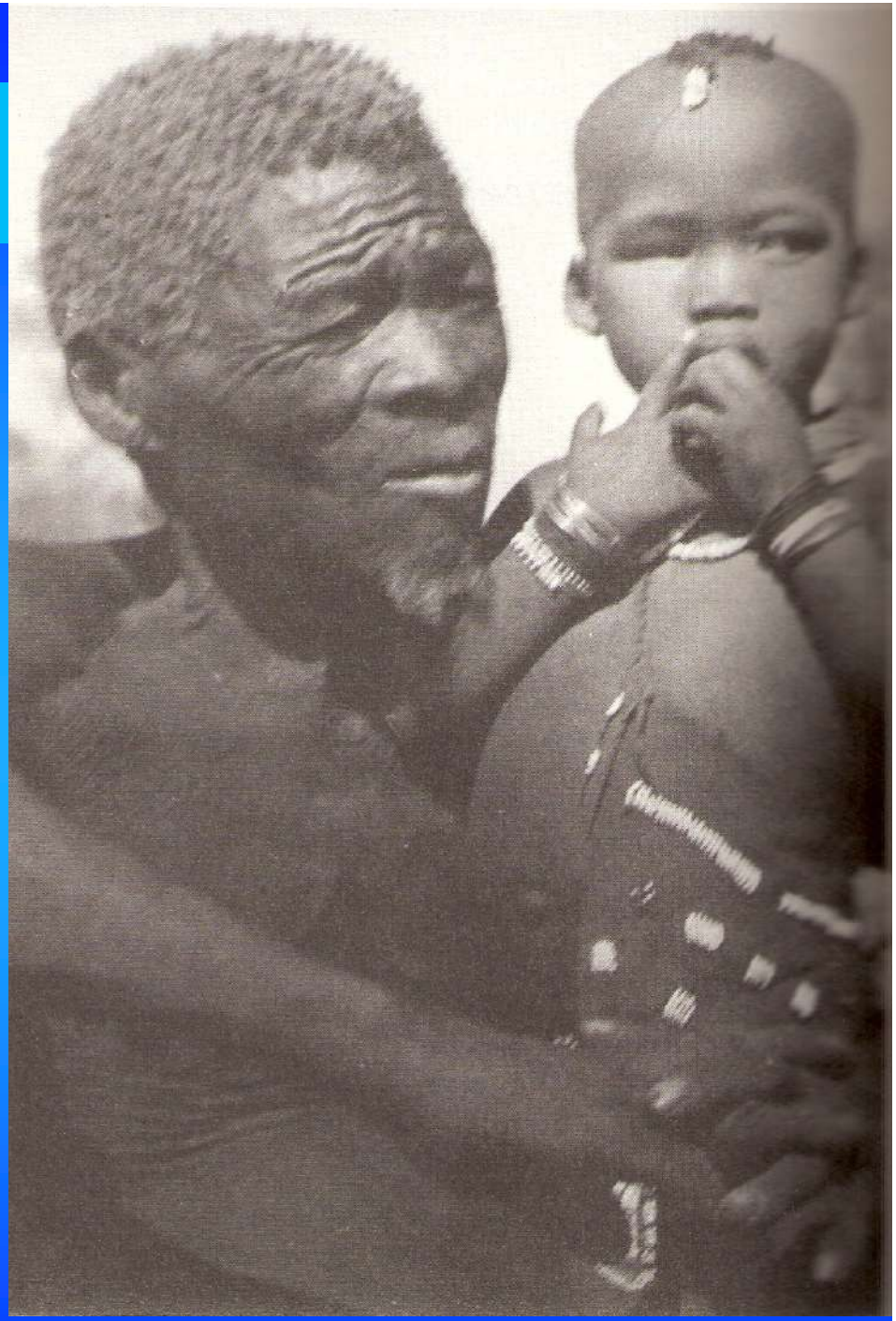
≠Toma once said of himself,
"From the day I was born, I was born for meat."

≠Toma returns from a foraging trip carrying a net lined with skin and filled with nuts. A gathering party of men and women would walk for several days over waterless country to pick clean the nut groves or the groundnut patches and would carry home their harvest in big leather bags that could hold from fifty to one hundred pounds of nuts.

Hominines were prey at Sterkfontein, "Cradle of Mankind"

Immediate feeding response to crying

Father frequently and closely involved ...



EXTREME EGALITARIANISM

EQUALITY (gender, age, capacity)

INTENSE SOCIAL COHESION

→ NO AGGRESSION !!!!!

UNIQUE

hominin feature:
carry food home
to share …

BERGMAN

'sharing phenotype'

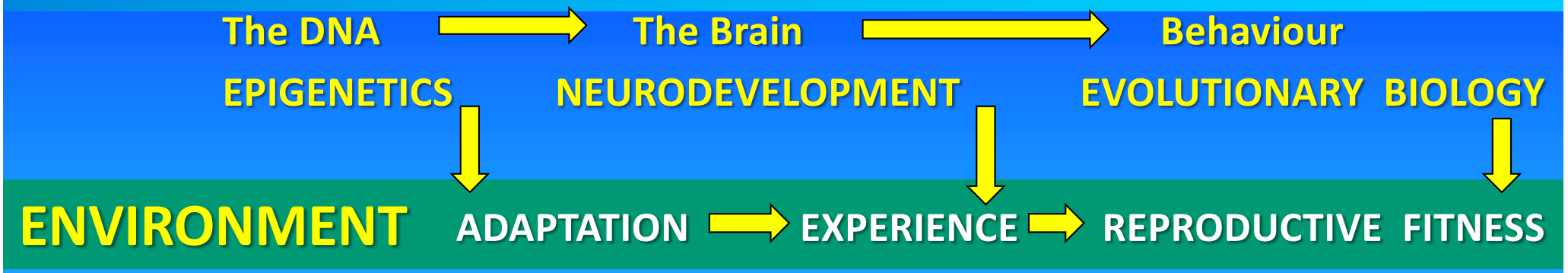
≠Toma returns from a foraging trip carrying a net lined with skin and filled with nuts. A gathering party of men and women would walk for several days over waterless country to pick clean the nut groves or the groundnut patches and would carry home their harvest in big leather bags that could hold from fifty to one hundred pounds of nuts.

THE HUNTER GATHERER (cont)

Infant care patterns in such societies
(which are closest to our origins):

1 Infant carried most of time
2 Mother sleeps with infant same bed
3 Immediate feeding response to crying
4 Breastfeeding 24 months or more
5 Father frequently and closely involved ...

NURTURESCIENCE



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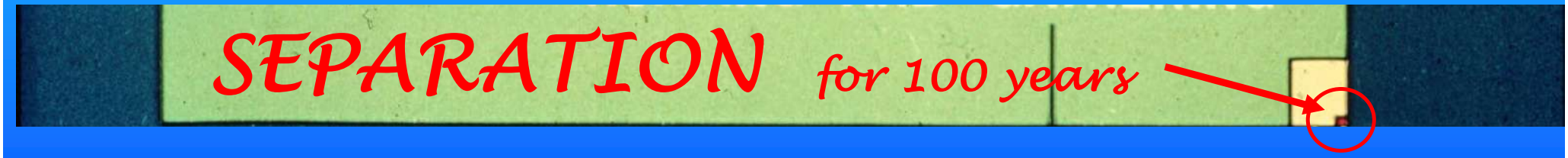
a new model with ancient roots.

a new model with ancient roots.

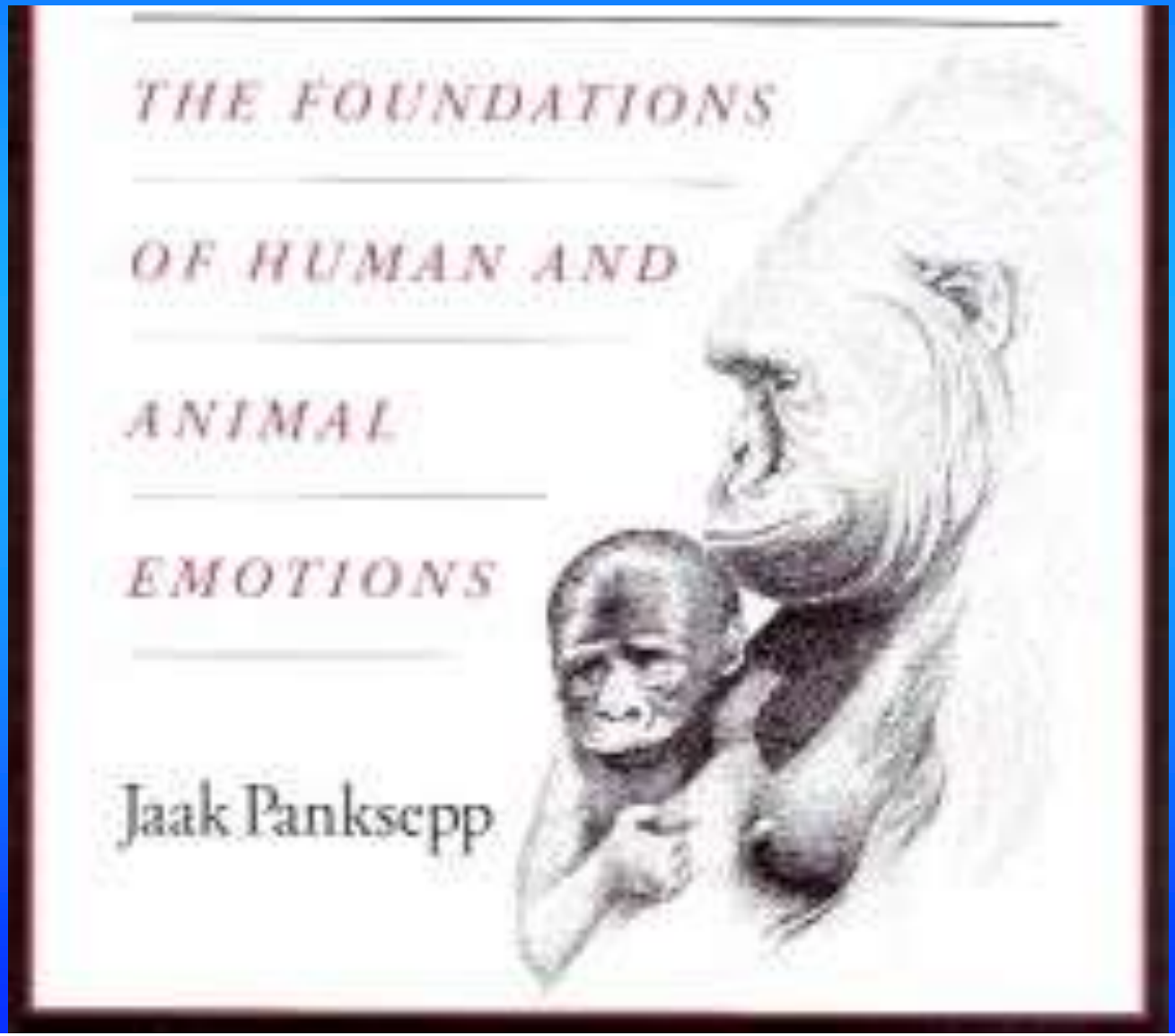
Introducing NURTURESCIENCE a new model with ancient roots.

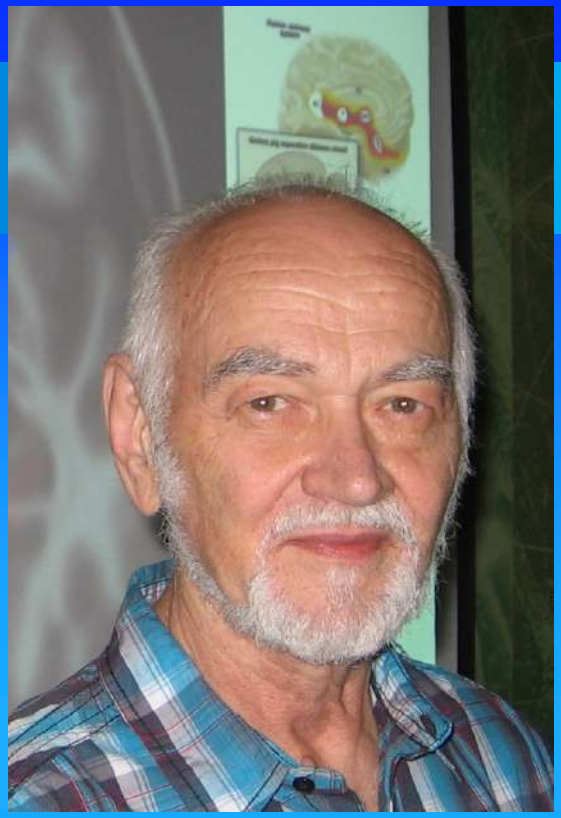
ZERO SEPARATION
for 30,000,000 years

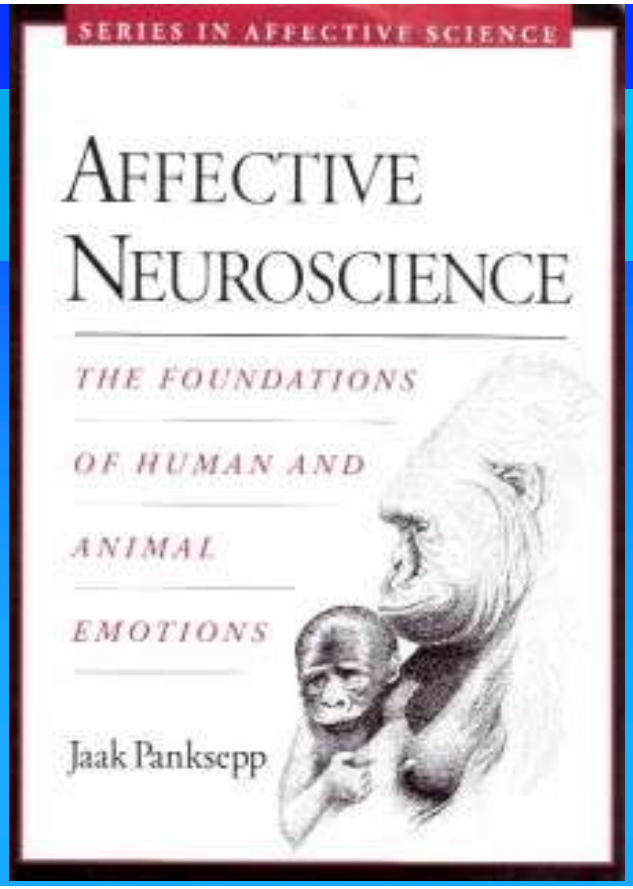


a new model with ancient roots.

Introducing NURTURESCIENCE a new model with ancient roots.







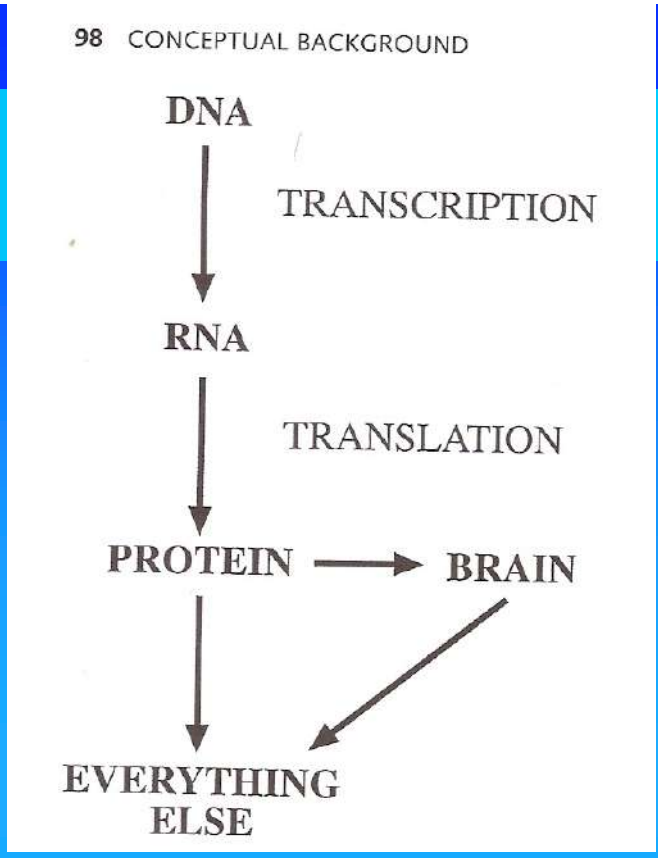
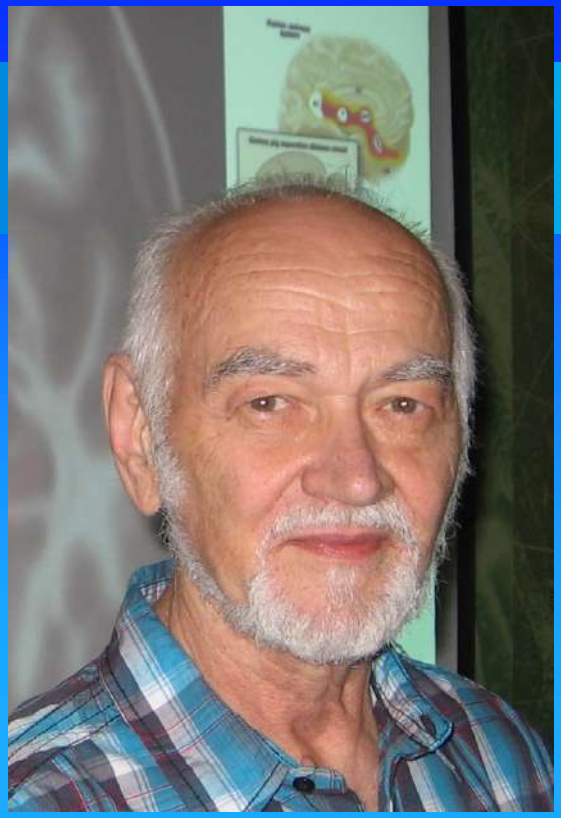
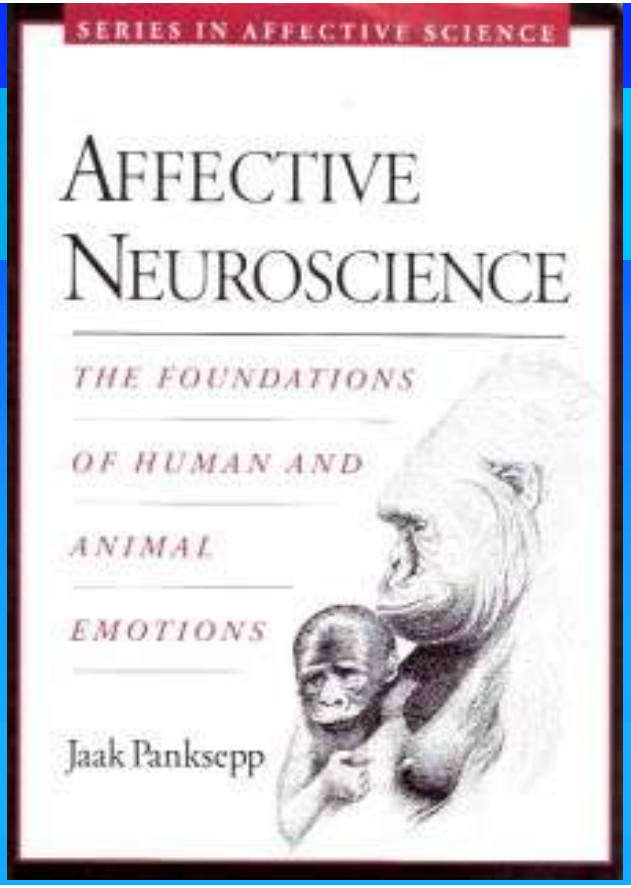


Figure 6.1. Summary of the current "central dogma" that underlies the analysis of all biological processes, including those that mediate basic psychobiological





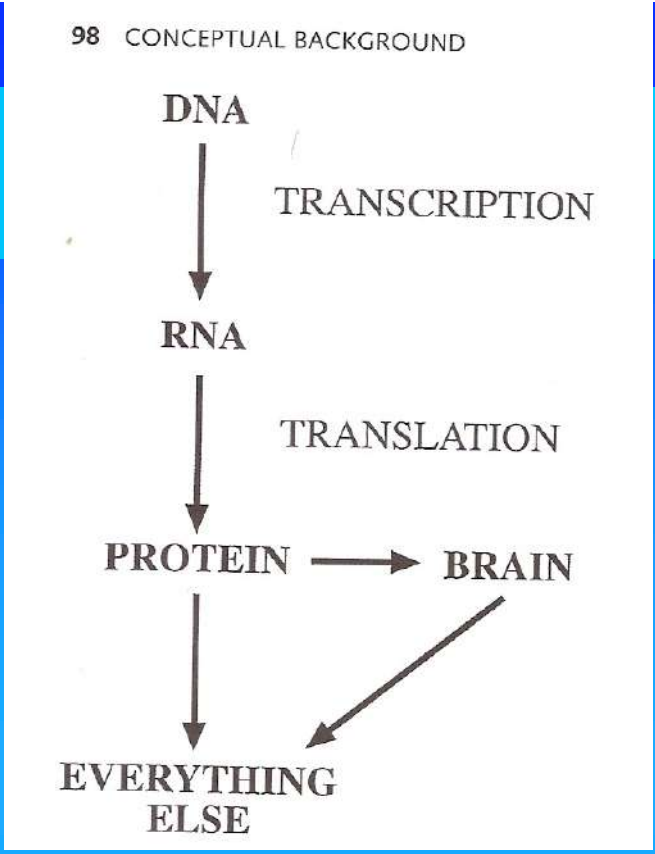
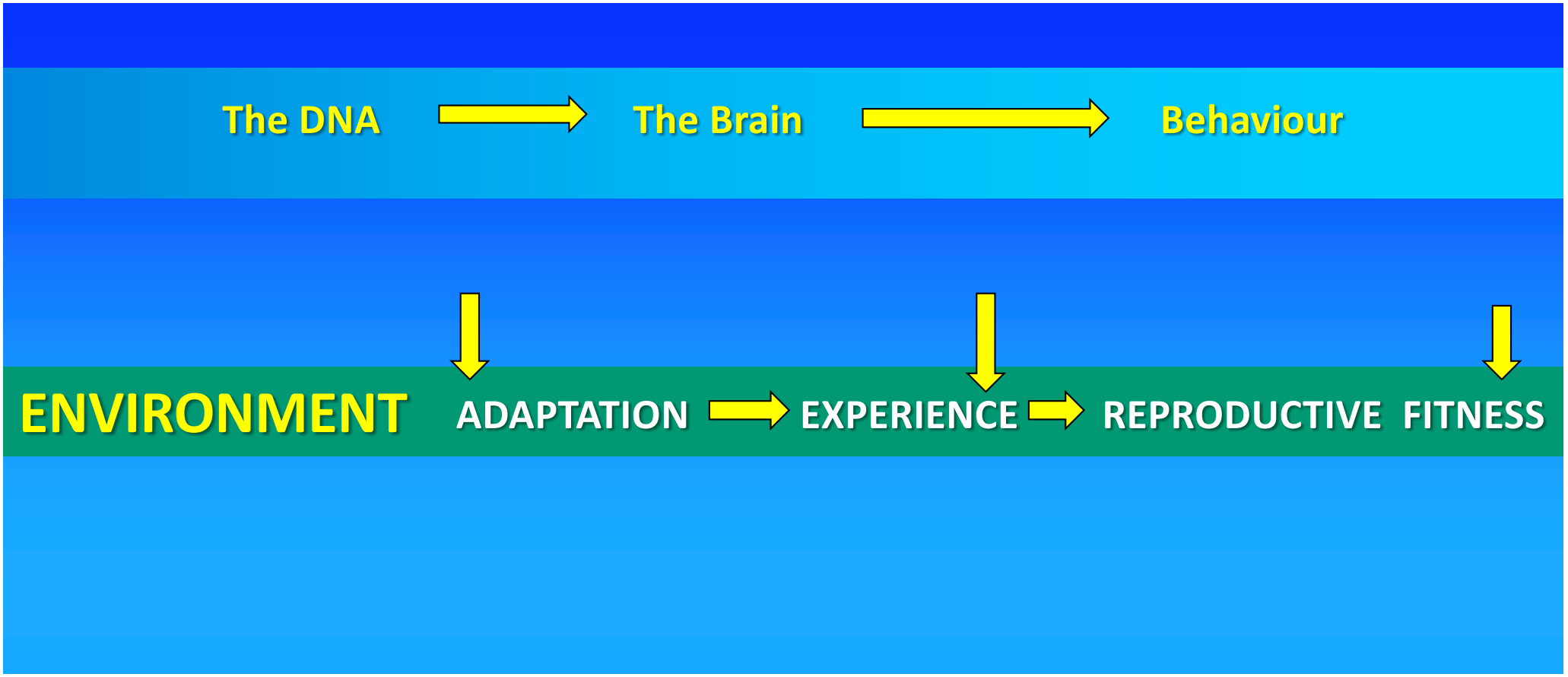


Figure 6.1. Summary of the current "central dogma" that underlies the analysis of all biological processes, including those that mediate basic psychobiological processes. The only major concept missing from this schematic is the environment, and these influences permeate all phases of these transactions.



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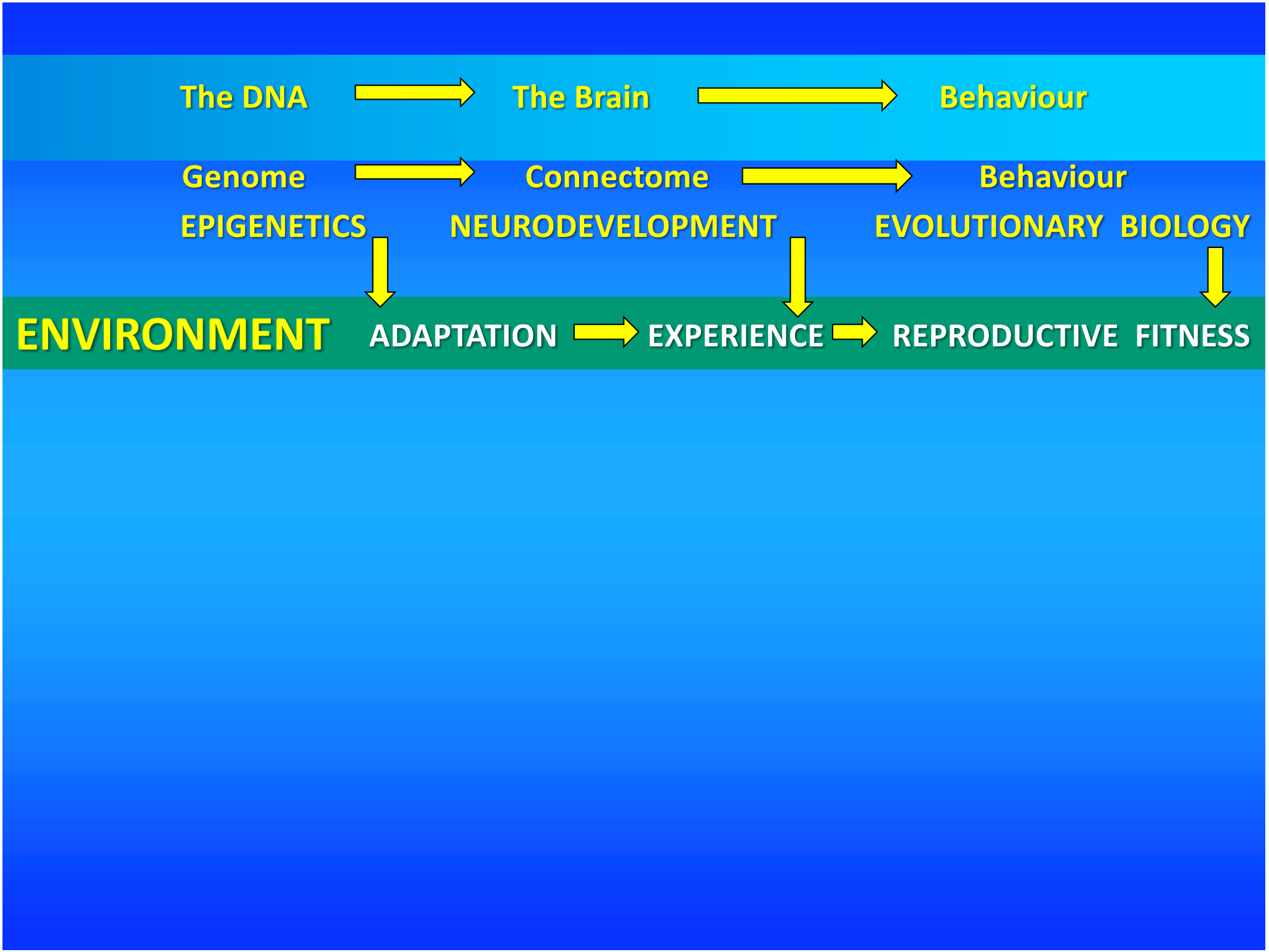
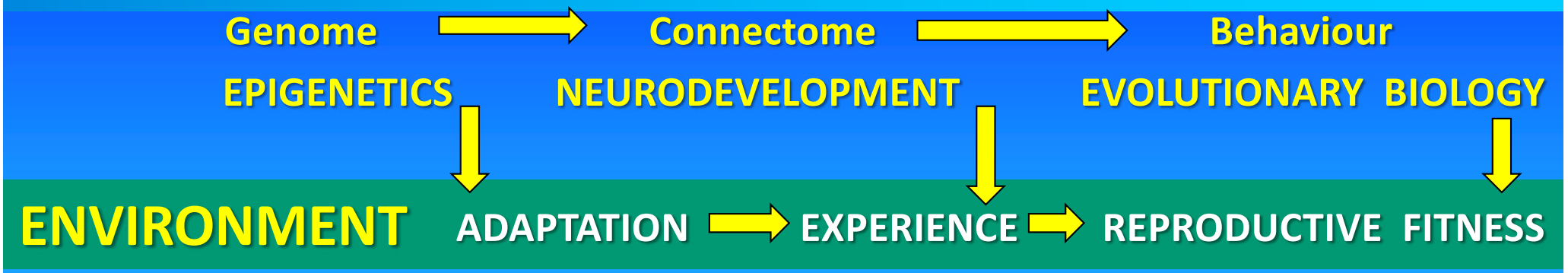
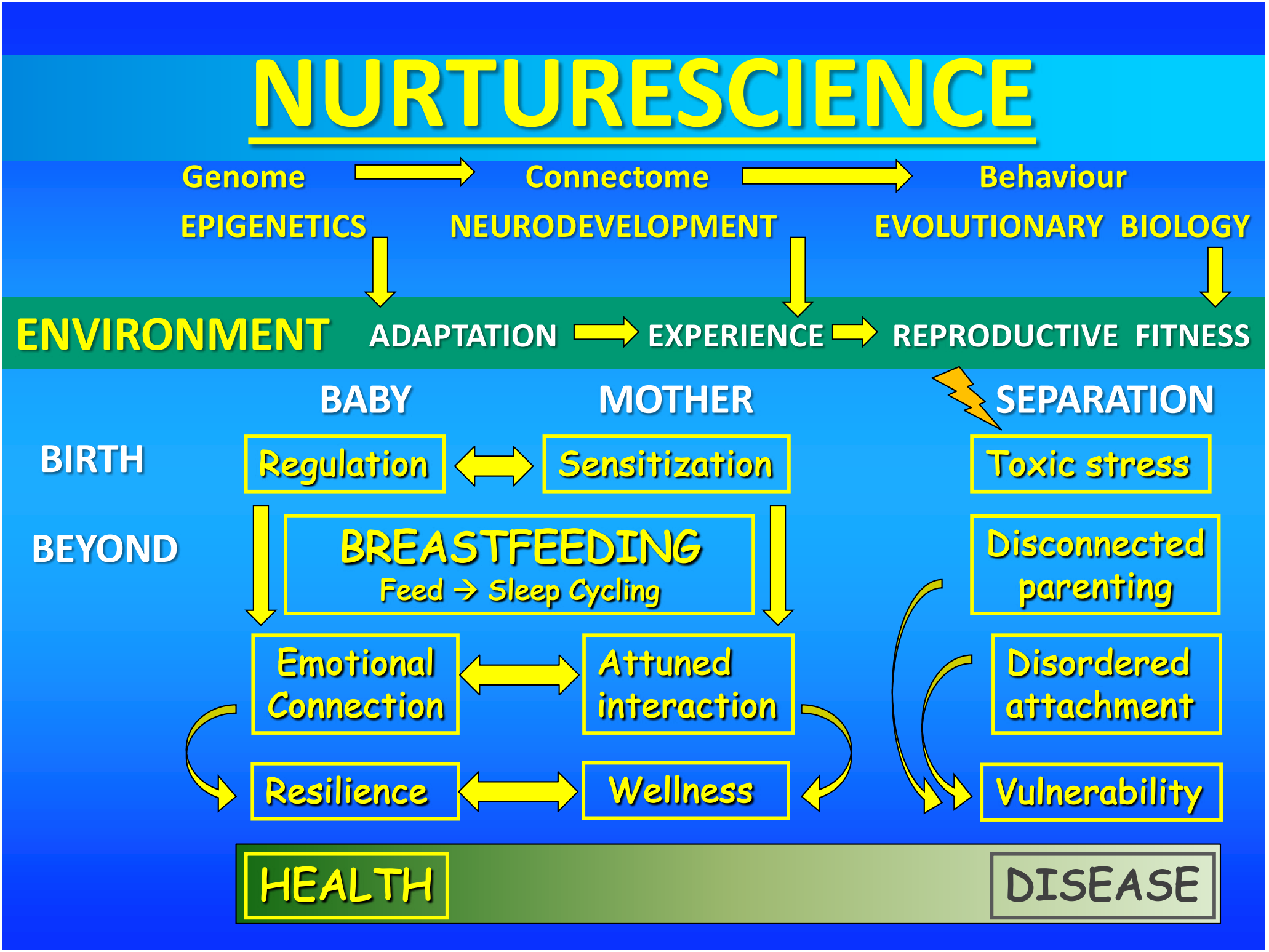

The DNA
The Brain
Behaviour
Genome
Connectome
Behaviour
EPIGENETICS
NEURODEVELOPMENT
EVOLUTIONARY BIOLOGY
ENVIRONMENT
ADAPTATION
EXPERIENCE
REPRODUCTIVE FITNESS

NURTURESCIENCE



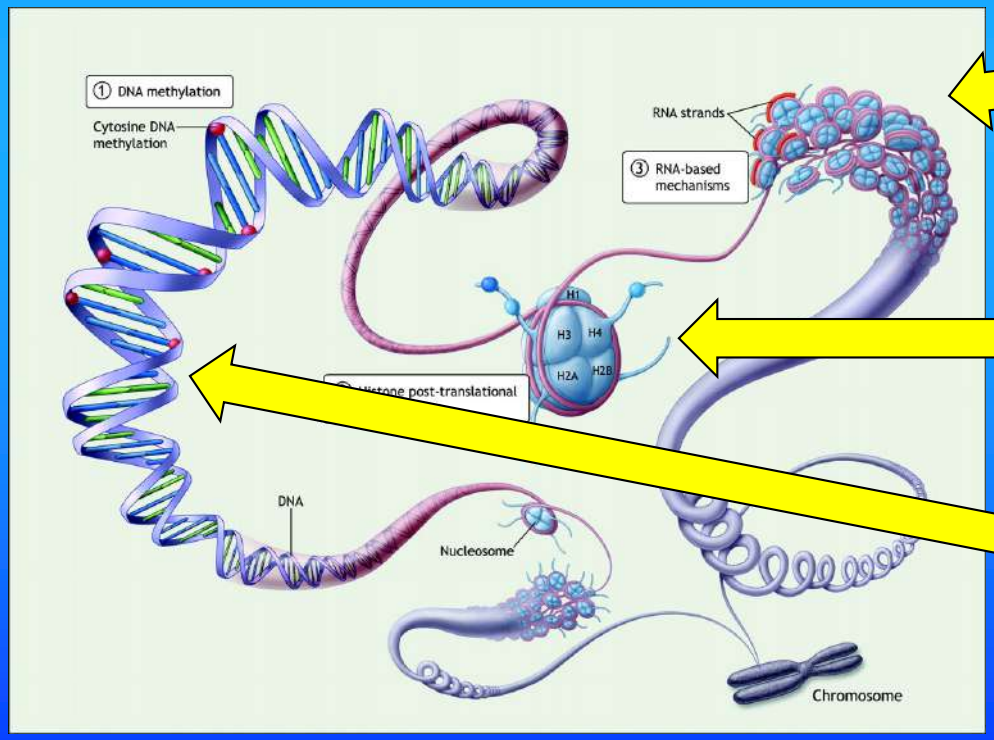

NURTURESCIENCE
Genome
Connectome
Behaviour
EPIGENETICS
NEURODEVELOPMENT
EVOLUTIONARY BIOLOGY
ENVIRONMENT
ADAPTATION
EXPERIENCE
REPRODUCTIVE FITNESS
BABY
MOTHER
SEPARATION
BIRTH
Regulation
Sensitization
Toxic stress
BEYOND
BREASTFEEDING
Feed → Sleep Cycling
Disconnected parenting
Emotional Connection
Attuned interaction
Disordered attachment
Resilience
Wellness
Vulnerability
HEALTH
DISEASE

NURTURESCIENCE

Genome → Connectome → Behaviour

EPIGENETICS NEURODEVELOPMENT EVOLUTIONARY BIOLOGY

ENVIRONMENT → ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

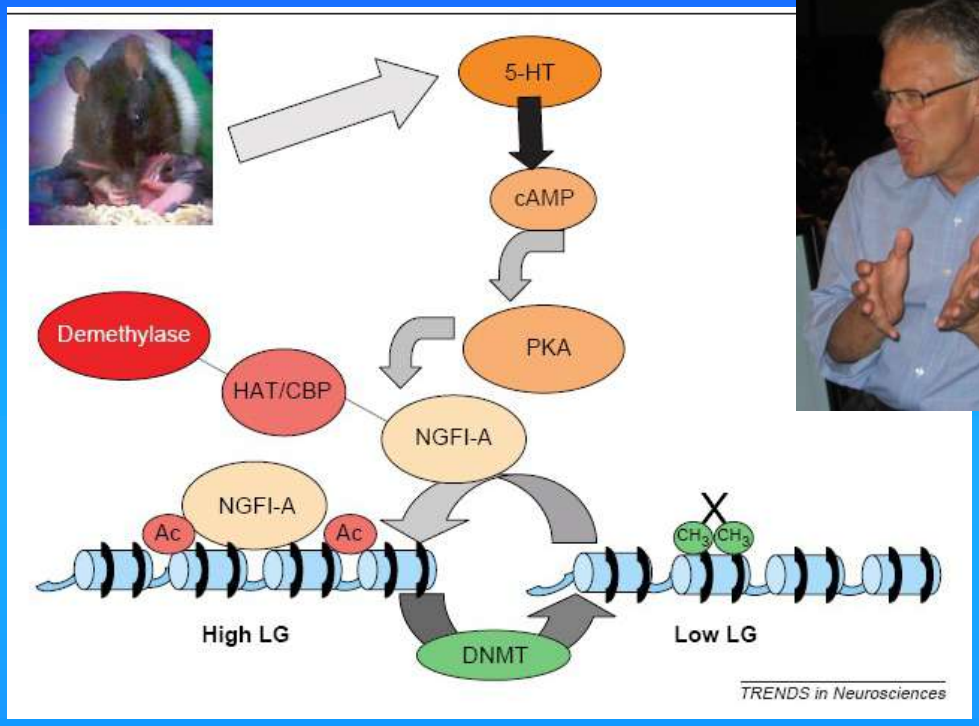


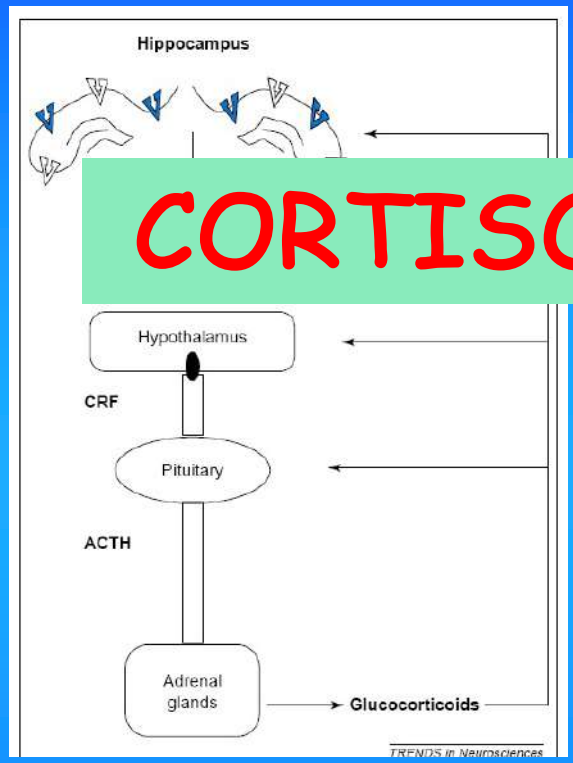
MICRO-RNA

HISTONE MODIFICATION

DNA METHYLATION

MICHAEL MEANEY epigenetics





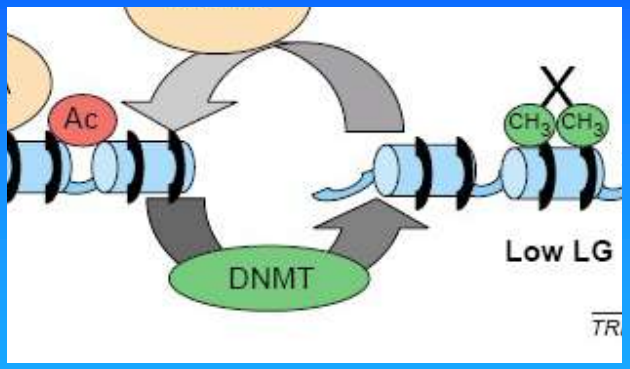
CORTISOL

Unsafe environment activates HPA axis (autonomic nervous system, ANS).

MOTHER
HG - High Grooming

MOTHER
Low Grooming LG

HG BABY



LG BABY

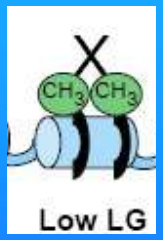
Healthy adult

UNHEALTHY adult

Makes MOTHER
HG – High Grooming

Makes MOTHER
Low Grooming - LG

HG BABY



HG BABY
LOW Grooming care

CORTISOL

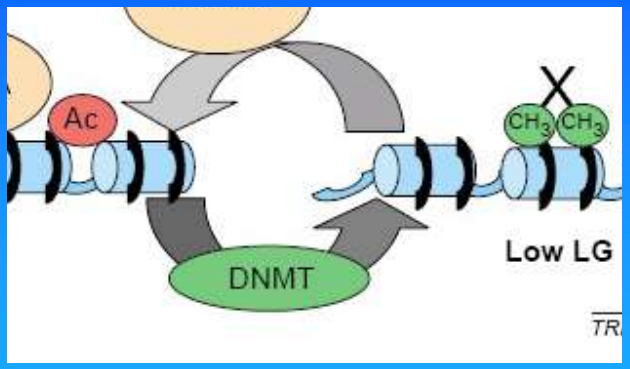
UNHEALTHY adult

Makes MOTHER
LOW Grooming LG

MOTHER
HG - High Grooming

MOTHER
Low Grooming LG

HG BABY



LG BABY

Healthy adult

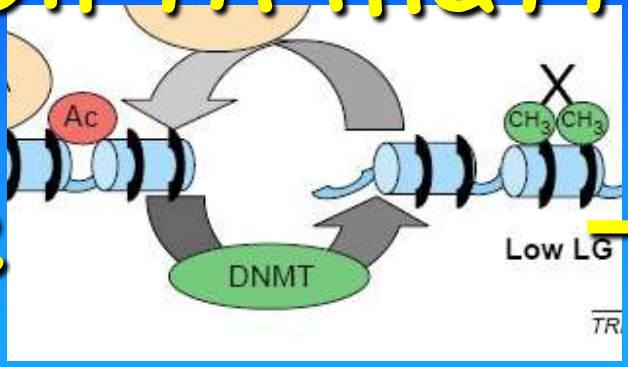
UNHEALTHY adult

Makes MOTHER
HG – High Grooming

Makes MOTHER
Low Grooming - LG

Early stress alters gene expression, with health impact across lifespan.

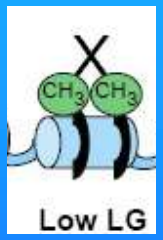
Earliest care at birth matters



Same gene → switched

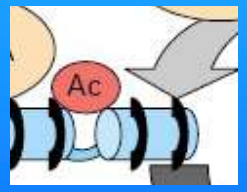
Makes MOTHER
HG – High Grooming

Makes MOTHER
Low Grooming - LG



LG BABY

HIGH grooming care

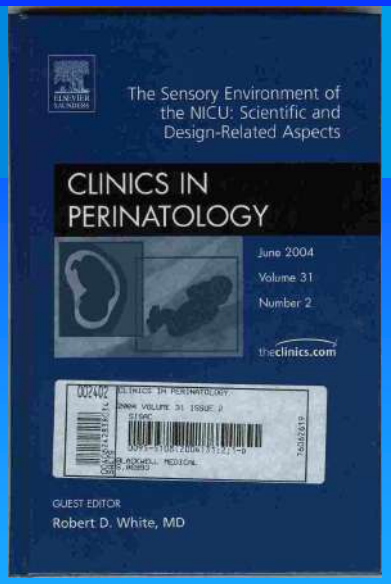


LG BABY

HEALTHY adult

Makes MOTHER
HIGH Grooming HG

OXYTOCIN



Clinics in Perinatology,
June 2004, Vol 31(2) page 210
Stanley Graven
Early neurosensory visual development of fetus and newborn.

"It is a serious mistake to assume that the principles derived from careful animal studies do not apply to human infants.

The Neuroscience of Birth & Breastfeeding

"It is a serious mistake to assume that the principles derived from careful animal studies do not apply to human infants.
The risk of suppression or disruption of *needed neural processes* ...
is very significant and potentially lasts a life time.

The Neuroscience of Birth & Breastfeeding

ENVIRONMENT ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

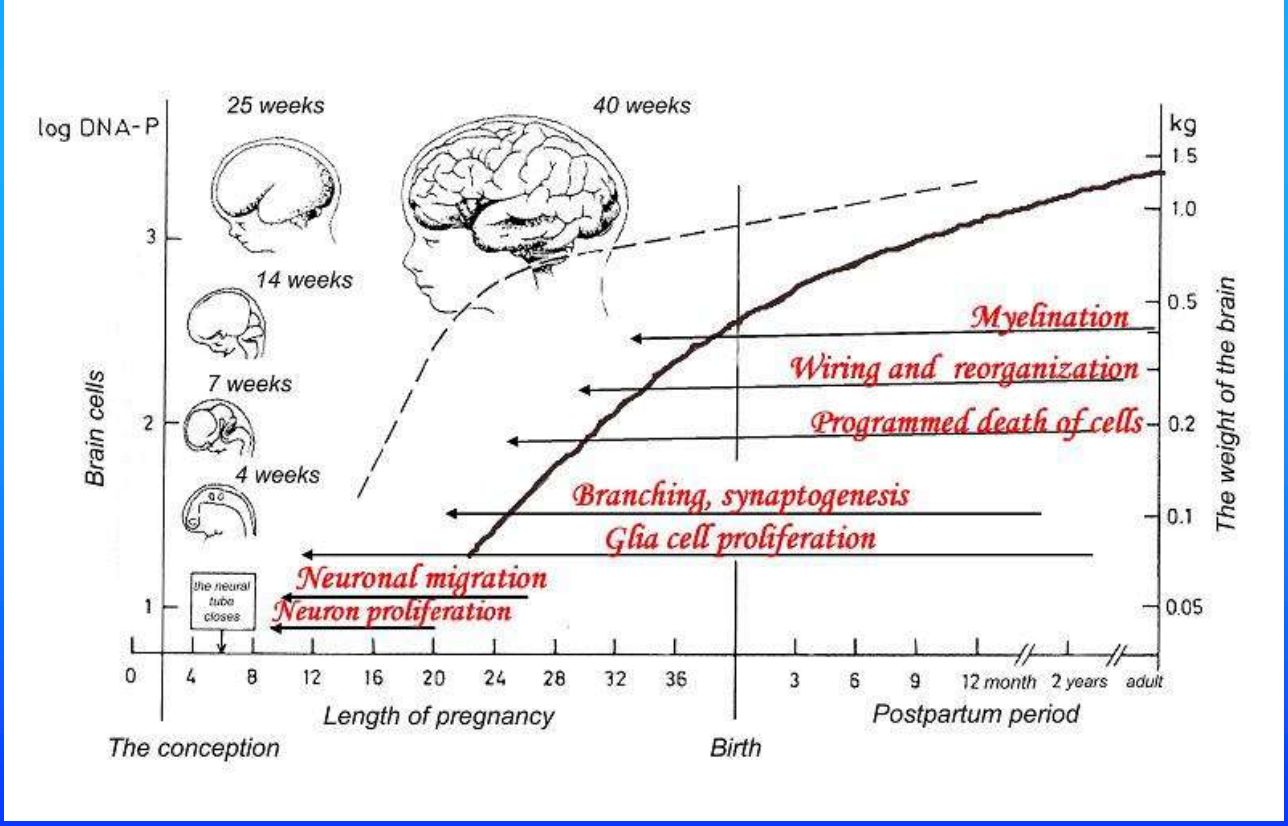
"needed neural processes"

NURTURESCIENCE

Genome → Connectome → Behaviour

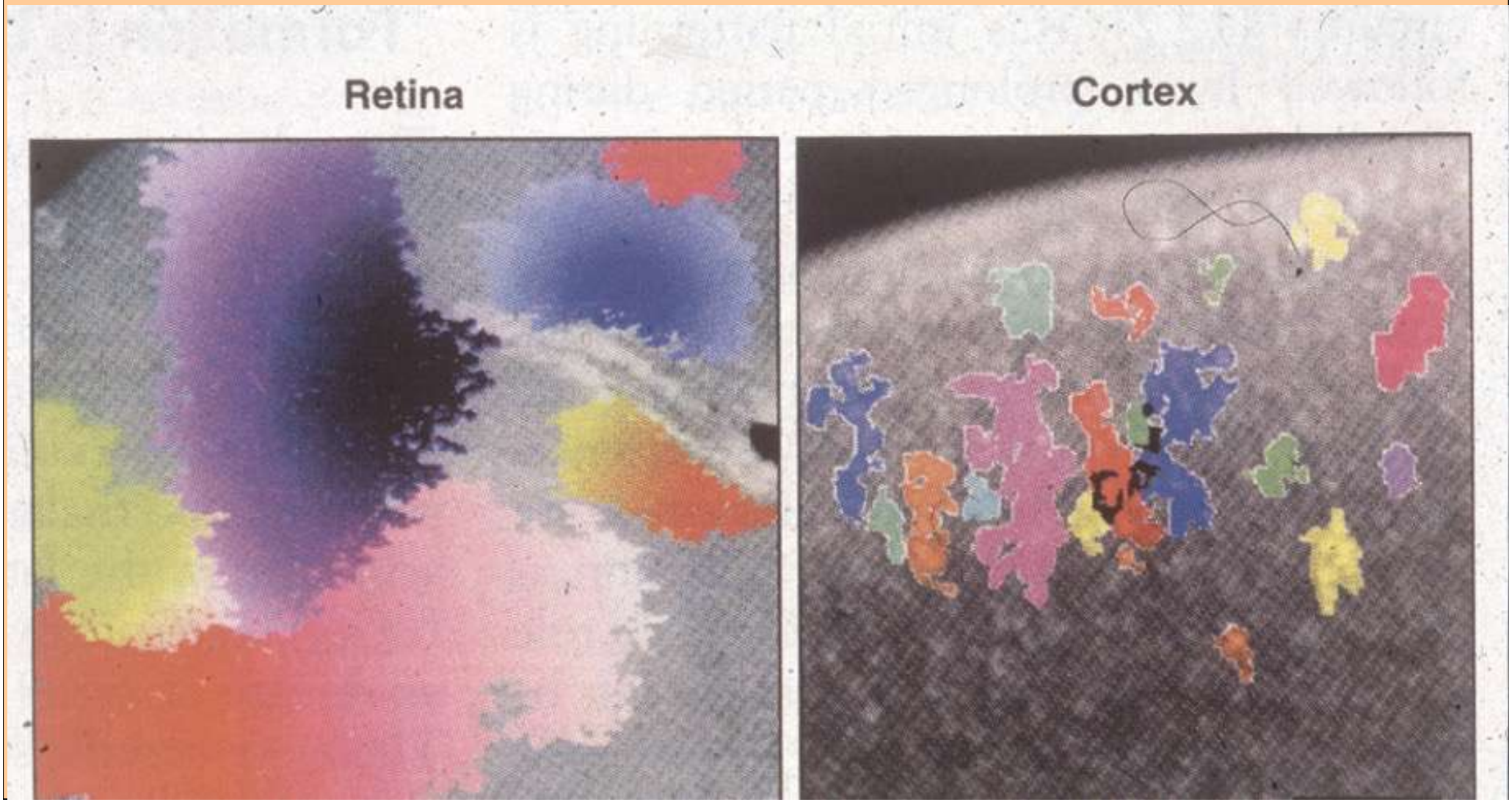
EPIGENETICS — NEURODEVELOPMENT — EVOLUTIONARY BIOLOGY

ENVIRONMENT → ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS



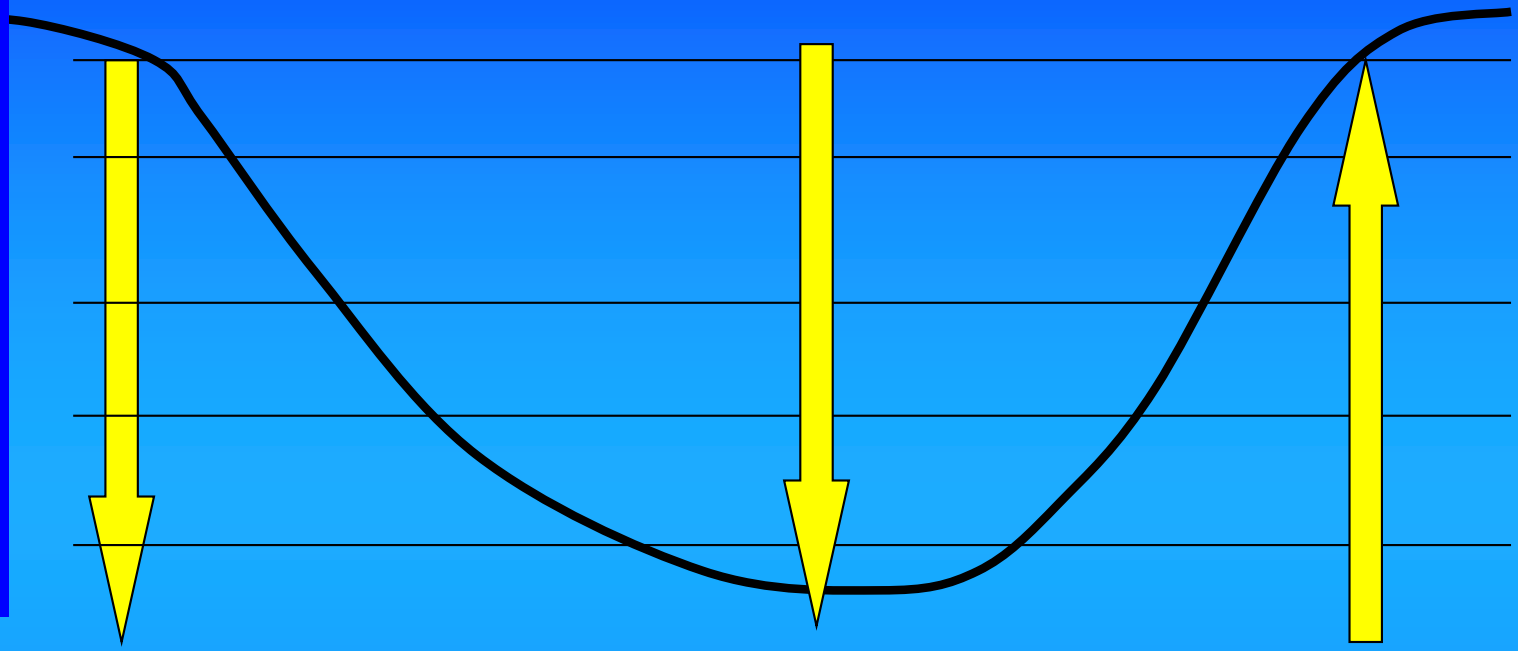
”Neurons that fire together wire together while those which don't,won't”

Hebb/Carla Shatz



BRAIN WIRING

REM
NR1
NR2
NR3
NR4



ACQUISITION

poly-sensory input
short-term memory
stored cortex

Awake and REM

CONSOLIDATION

transfer information
"SNR" strong signals
amygdala / hippocampus
NREM stage 4

MEMORY FORMATION

P waves
returns info
to neocortex:
organized
REM

Sleep, Hormones, and Memory

Jan Born, PhD[a,*], Ullrich Wagner, PhD[b]

Obstet Gynecol Clin N Am 36 (2009) 809–829

This article follows the hypothesis that a primary function of sleep pertains to the consolidation of memory. In recent years, this view has received substantial support from a rapidly growing number of experiments performed in various species and at different levels of beh oral, cellular, and molecular analysis.[2–7]

In adult:
sleep pertains
to memory

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In adult:
sleep pertains to memory

In child:
neurodevelopment (brain wiring)
1st 1000 days

BRAIN WIRING

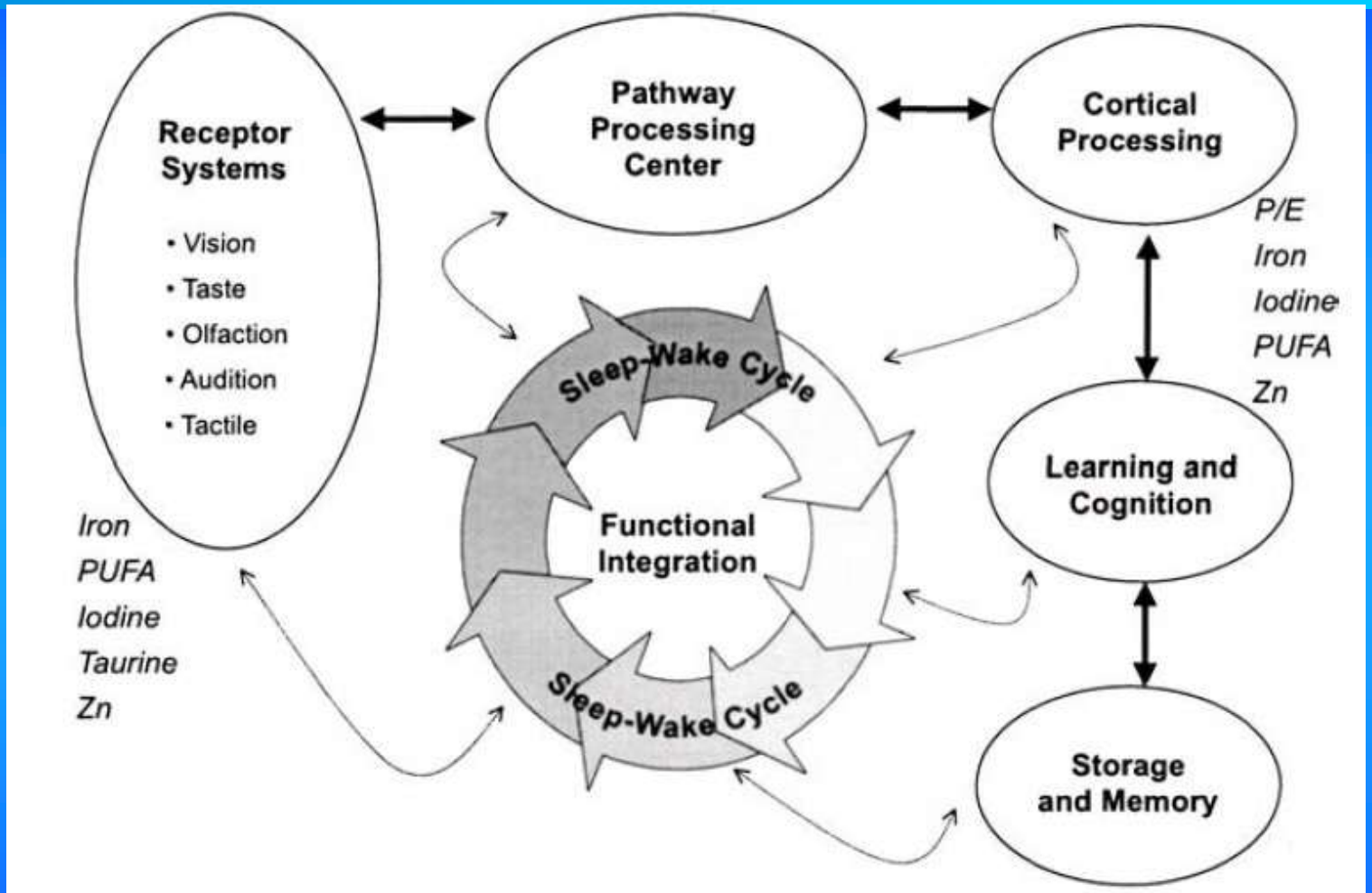
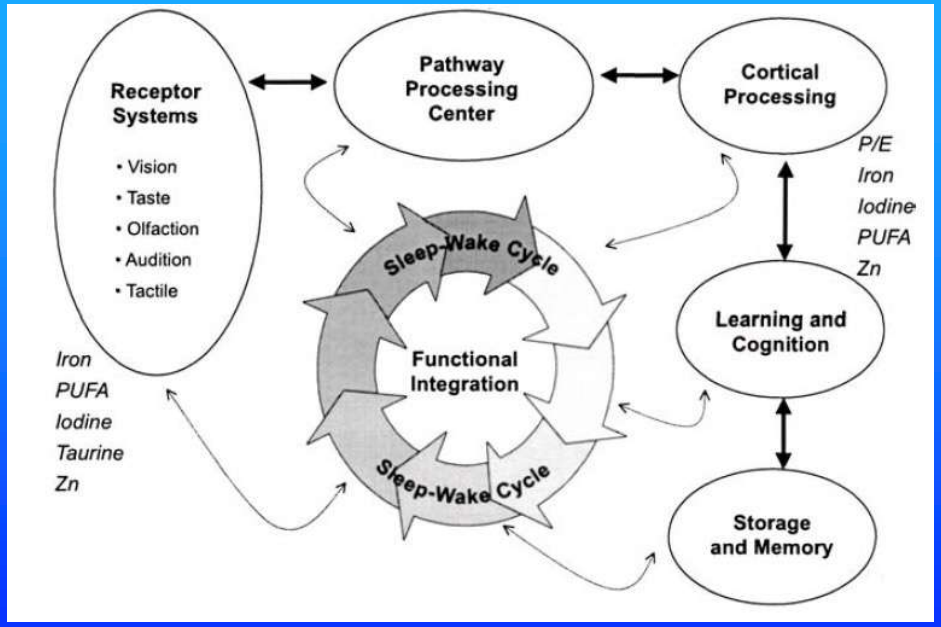


Fig 4. Schematic representation of the interaction between sensory receptors and CNS functions within the framework of the sleep-wake cycle. Nutrients with proven effects on sensory receptors and/or cortical processing are included (*PUFA*, polyunsaturated fatty acids; *Zn*, zinc; *P/E*, protein/energy).

Peirano 2003

Brain Architecture and Skills are Built in a Hierarchical "Bottom-Up" Sequence

- **Neural circuits that process basic information are wired earlier than those that process more complex information.**

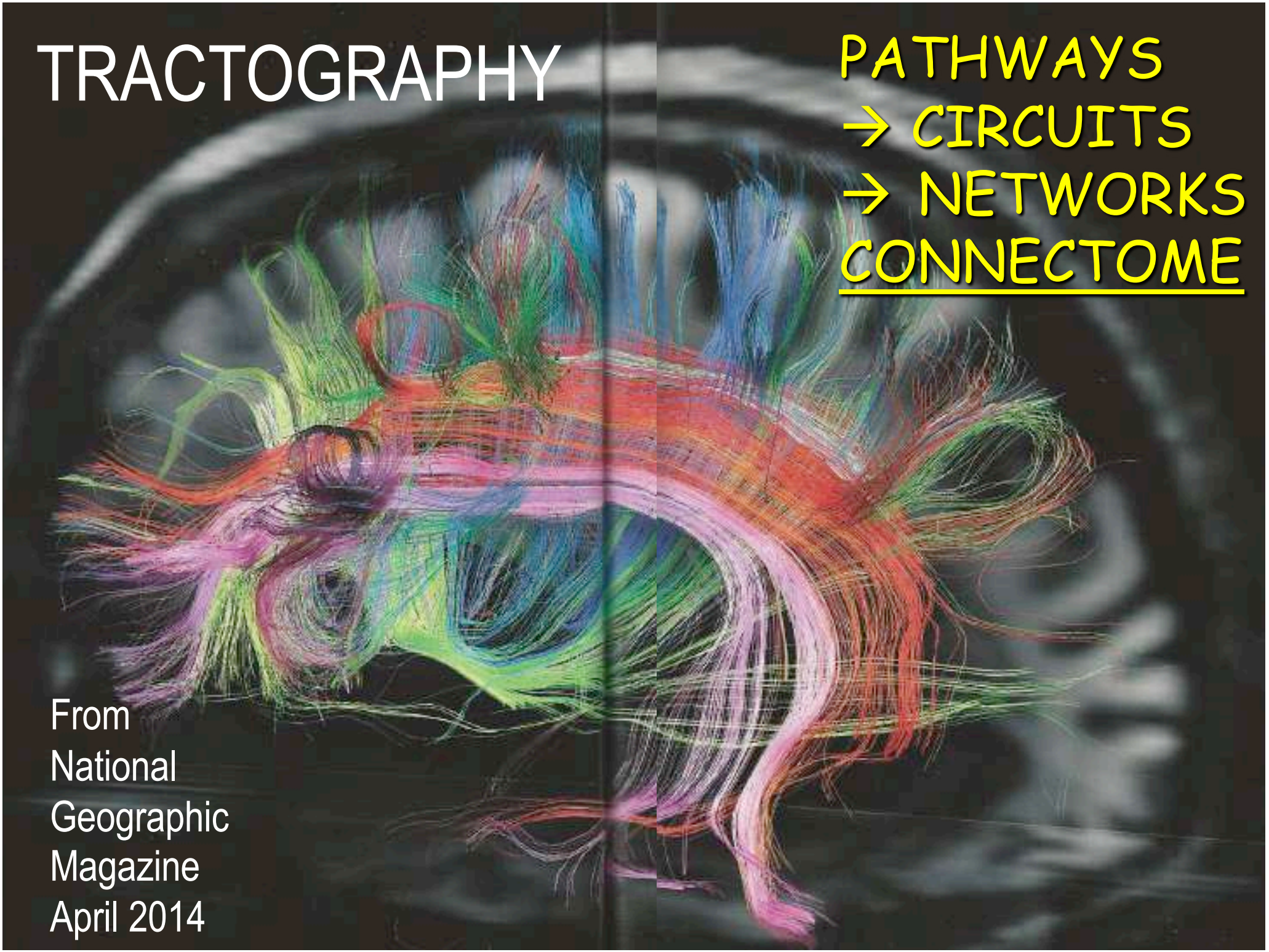


Slide by: Jack P. Shonkoff, M.D.

Brain Architecture and Skills are Built in a Hierarchical "Bottom-Up" Sequence

- **Neural circuits that process basic information are wired earlier than those that process more complex information.**
- **Higher circuits build on lower circuits, and skill development at higher levels is more difficult if lower level circuits are not wired properly.**

Slide by: Jack P. Shonkoff, M.D.


TRACTOGRAPHY
PATHWAYS
→ CIRCUITS
→ NETWORKS
CONNECTOME
From
National
Geographic
Magazine
April 2014

NURTURESCIENCE

Genome → Connectome → Behaviour

EPIGENETICS NEURODEVELOPMENT EVOLUTIONARY BIOLOGY

ENVIRONMENT ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

NURTURESCIENCE

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EPIGENETICS NEURODEVELOPMENT EVOLUTIONARY BIOLOGY

ENVIRONMENT ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

Newborn behaviour to locate the breast when skin-to-skin: a possible method for enabling early self-regulation

A-M Widström (ann-marie.widstrom@ki.se)[1], G Lilja[2], P Aaltomaa-Michalias[3], A Dahlöf[3], M Lintula[4], E Nissen[1,5]

DOI:10.1111/j.1651-2227.2010.01983.x

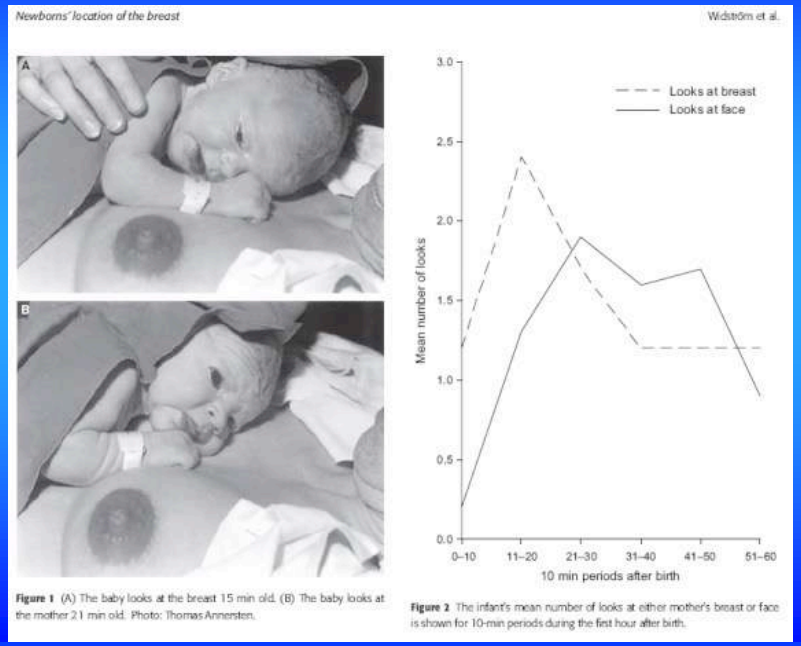

Figure 1 (A) The baby looks at the breast 15 min old. (B) The baby looks at the mother 21 min old. Photo: Thomas Annersten.

Figure 2 The infant's mean number of looks at either mother's breast or face is shown for 10-min periods during the first hour after birth.

Table 1 Definition of phases/behaviours identified

Phases	Behaviours
Birth cry	Intense crying just after birth
Relaxation phase	Infant resting/recovering. No activity of mouth, head, arms, legs or body
Awakening phase	Infant begins to show signs of activity. Small thrusts of head: up, down, from side-to-side. Small movements of limbs and shoulders
Active phase	Infant moves limbs and head, is more determined in movements. Rooting activity, 'pushing' with limbs without shifting body
Crawling phase	'Pushing' which results in shifting body
Resting phase	Infant rests, with some activity, such as mouth activity, sucks on hand
Familiarization	Infant has reached areola/nipple with mouth positioned to brush and lick areola/nipple
Suckling phase	Infant has taken nipple in mouth and commences suckling
Sleeping phase	The baby has closed its eyes

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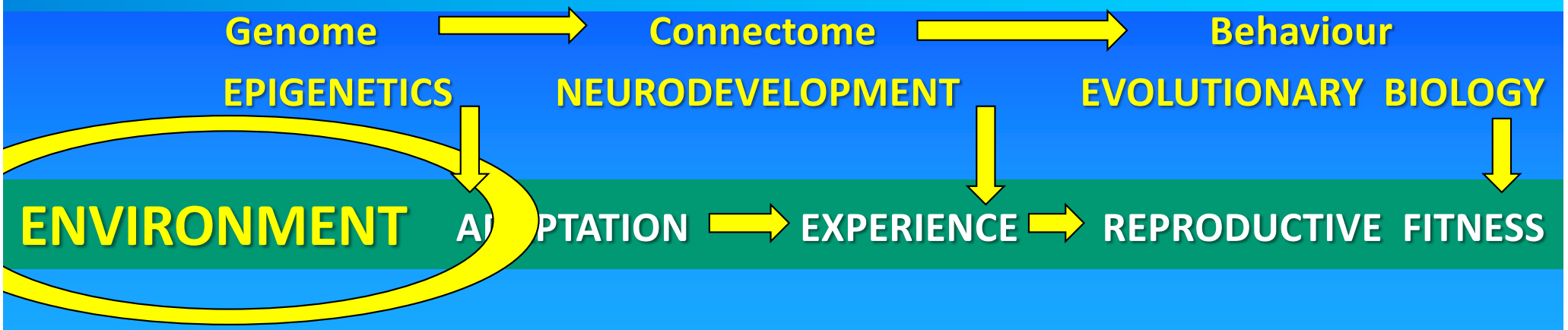
NURTURESCIENCE

HIGHLY CONSERVED
NEURO-ENDOCRINE
BEHAVIOR

ZERO SEPARATION
for 30,000,000 years

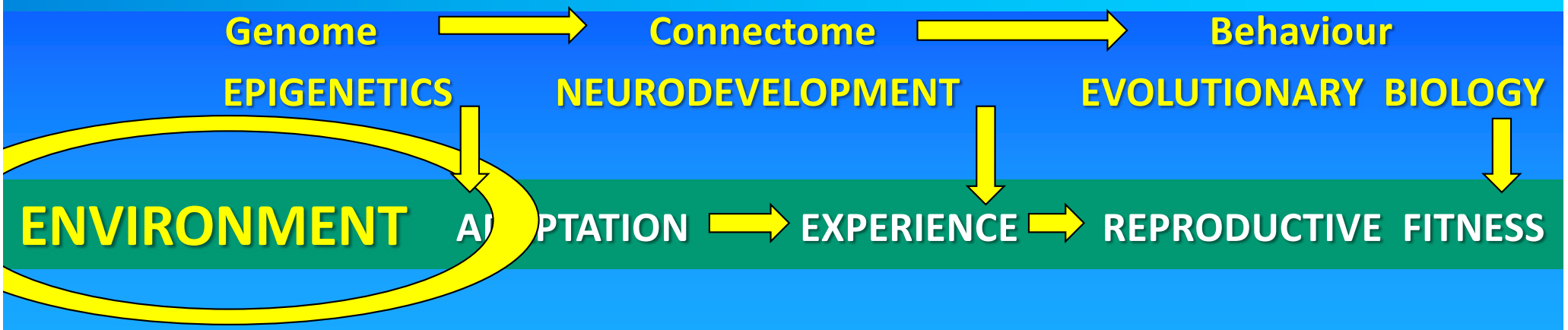
NURTURESCIENCE



"For species such as primates, the mother IS the environment."

Sarah Blaffer Hrdy, Mother Nature (1999)

NURTURESCIENCE



Nothing an infant can or cannot do makes sense,

except in light of mother's body

NURTURESCIENCE

Genome → Connectome → Behaviour

EPIGENETICS NEURODEVELOPMENT EVOLUTIONARY BIOLOGY

ENVIRONMENT A[illegible]PTATION → EXPERIENCE → REPRODUCTIVE FITNESS

except in light of mother's body

NURTURESCIENCE

Essentially ecological:

except in light of mother's body

NURTURESCIENCE

Essentially ecological:

ENVIRONMENT ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

BABY MOTHER

BONDING ⟷ Sensitization

ecology

/ɪˈkɒlədʒi,ɛˈkɒlədʒi/

noun

The branch of biology that deals with the relations of organisms to one another and to their physical surroundings.

(from Greek: οἶκος, "house", or "environment"; -λογία, "study of")

Introducing NURTURESCIENCE a new model with ancient roots.

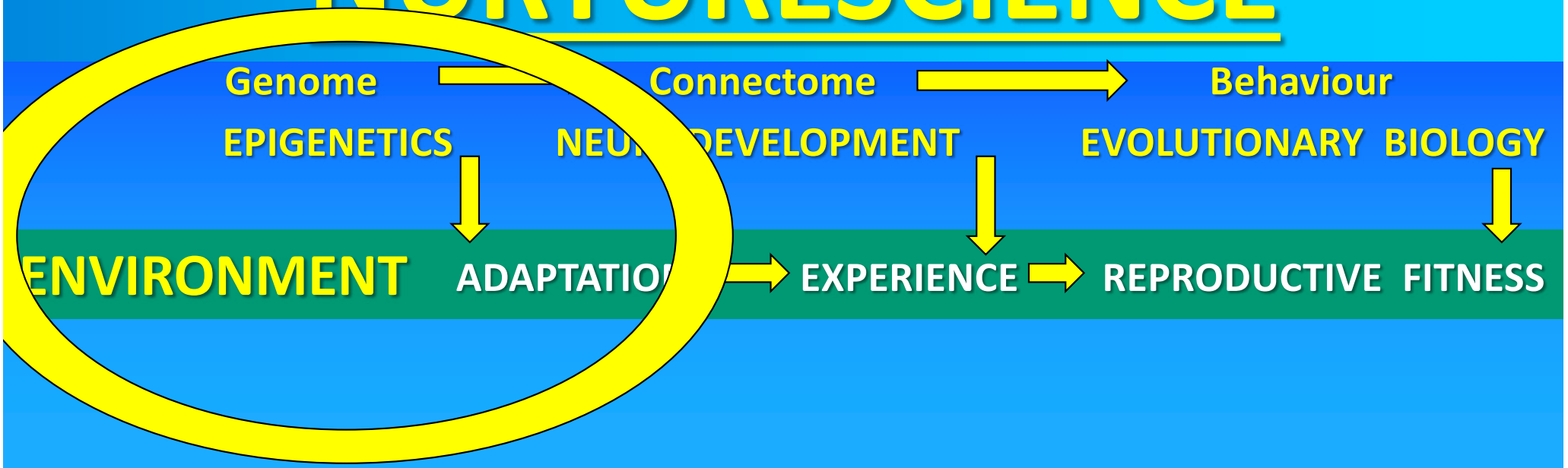
NURTURE and NATURE was all there was.

"Womb ecology becomes world ecology."
(APPPAH)

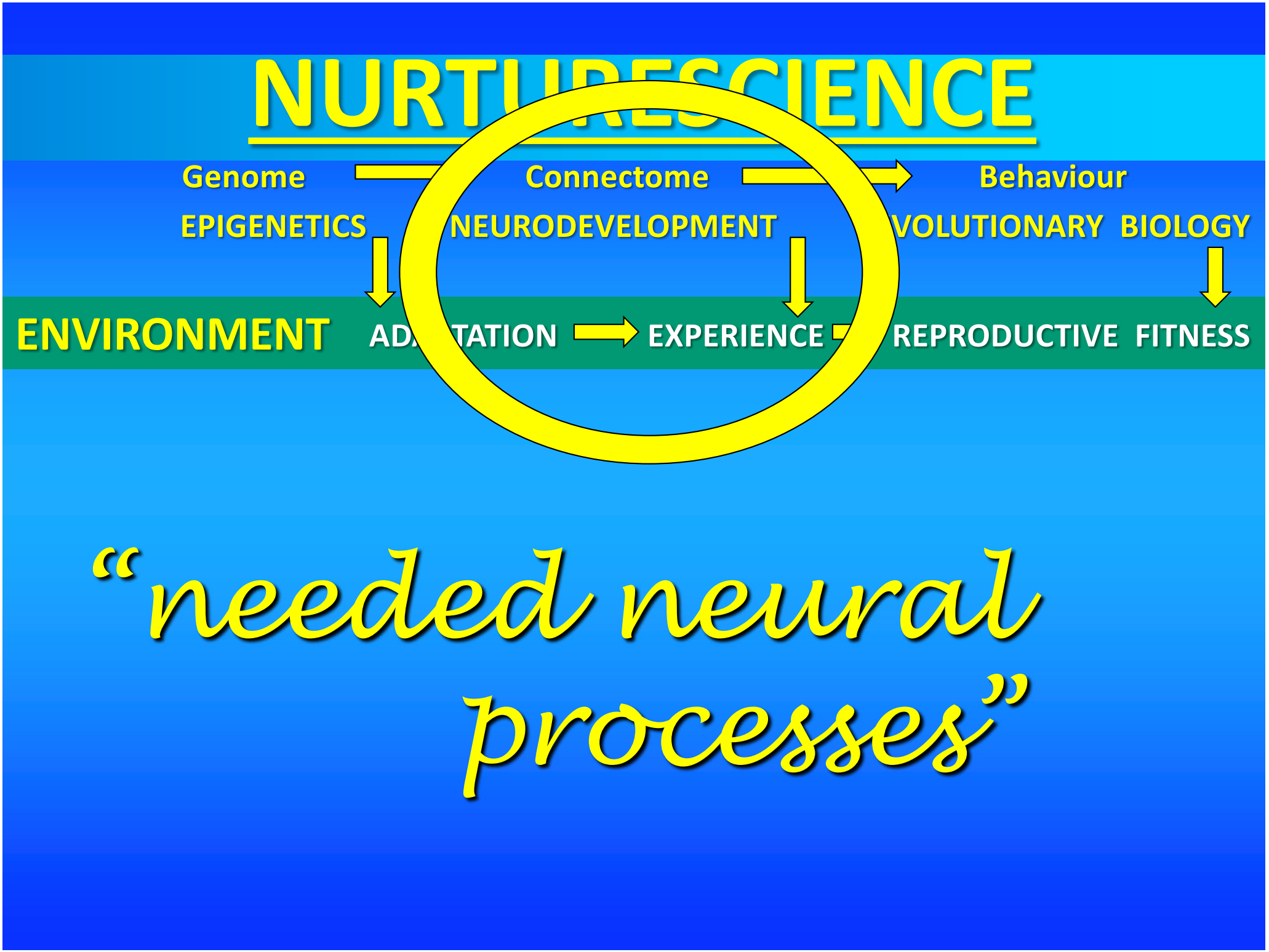
The branch of biology that deals with the relations of organisms to one another and to their physical surroundings.

https://birthpsychology.com/

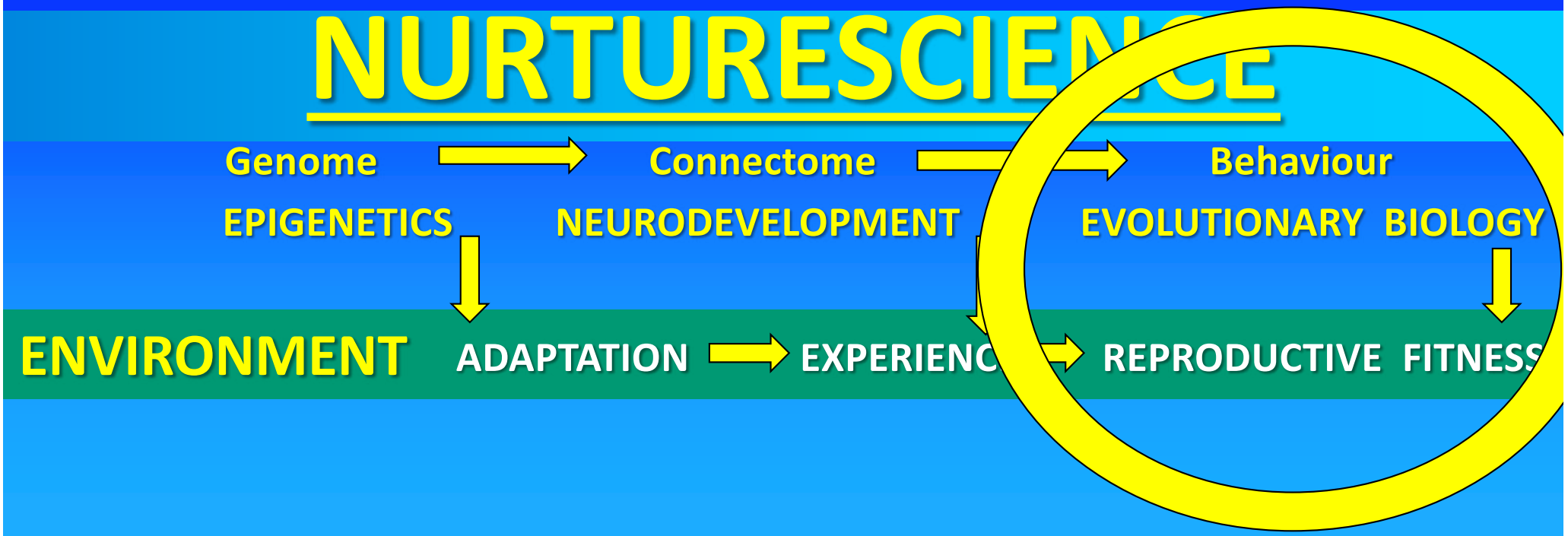
NURTURESCIENCE



"buffering protection of adult support"

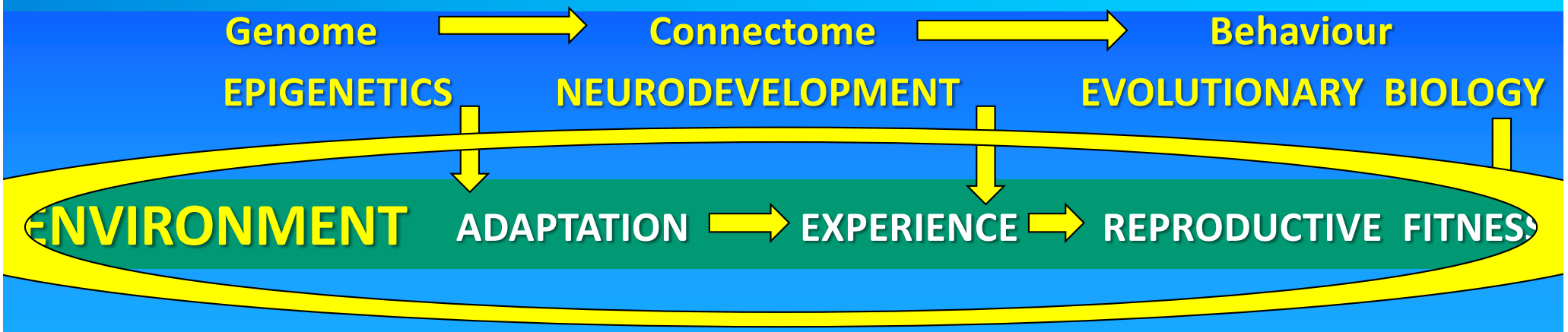

NURTURESCIENCE
Genome
Connectome
Behaviour
EPIGENETICS
NEURODEVELOPMENT
VOLUTIONARY BIOLOGY
ENVIRONMENT
AD TATION
EXPERIENCE
REPRODUCTIVE FITNESS
"needed neural processes"

NURTURESCIENCE

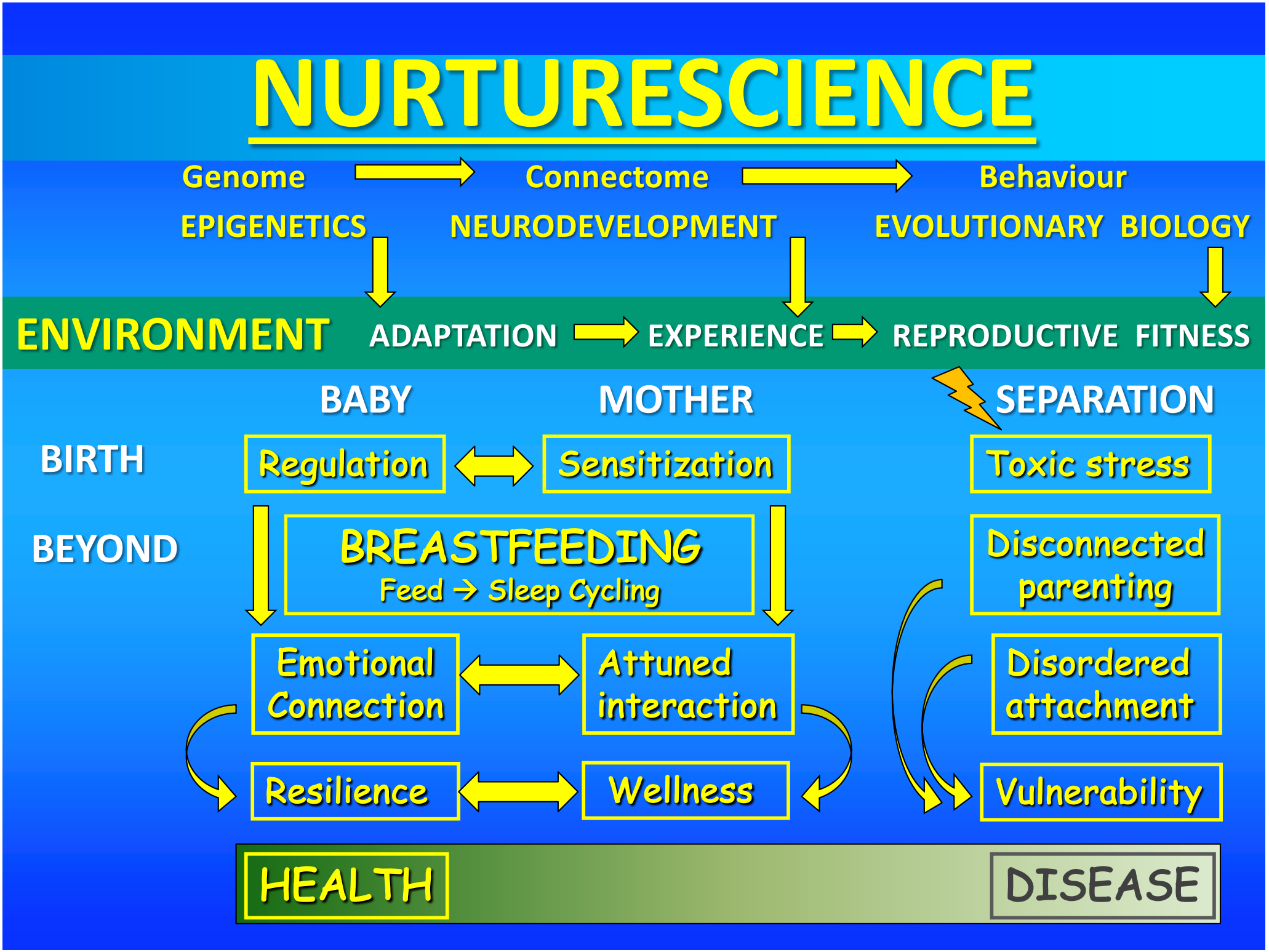


"except in the light of mother's body."

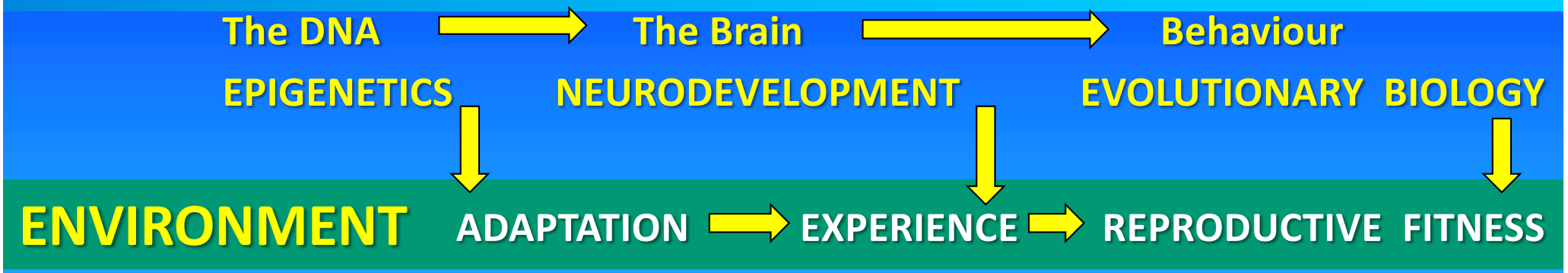
NURTURESCIENCE

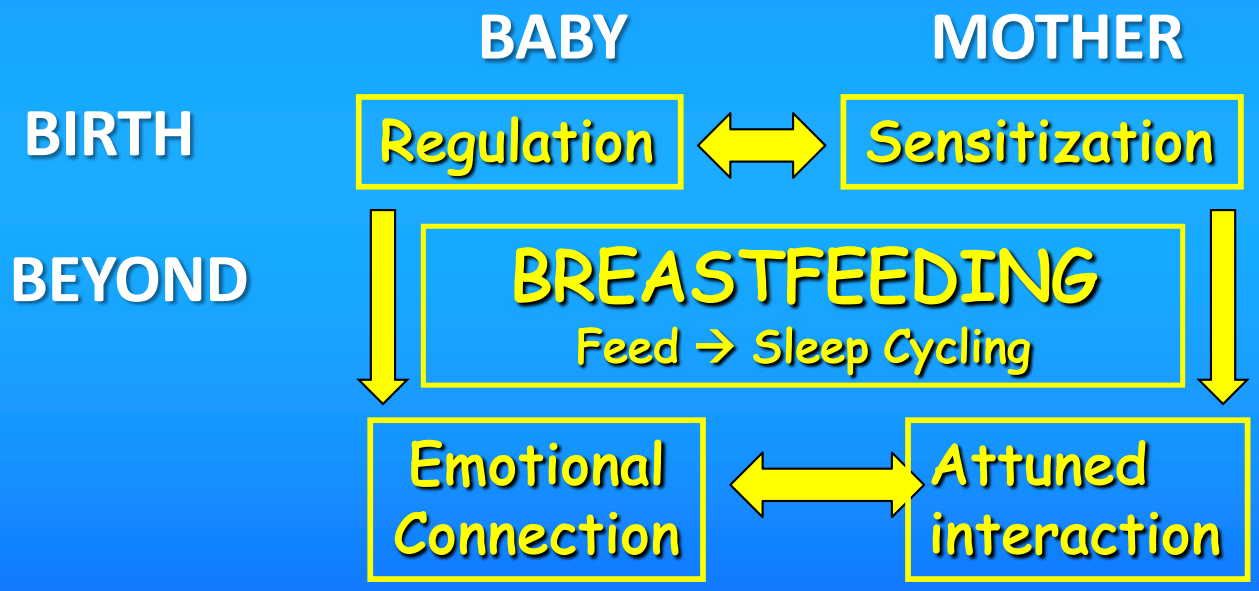


ZERO SEPARATION


NURTURESCIENCE
Genome
Connectome
Behaviour
EPIGENETICS
NEURODEVELOPMENT
EVOLUTIONARY BIOLOGY
ENVIRONMENT
ADAPTATION
EXPERIENCE
REPRODUCTIVE FITNESS
BABY
MOTHER
SEPARATION
BIRTH
Regulation
Sensitization
Toxic stress
BEYOND
BREASTFEEDING
Feed → Sleep Cycling
Disconnected parenting
Emotional Connection
Attuned interaction
Disordered attachment
Resilience
Wellness
Vulnerability
HEALTH
DISEASE

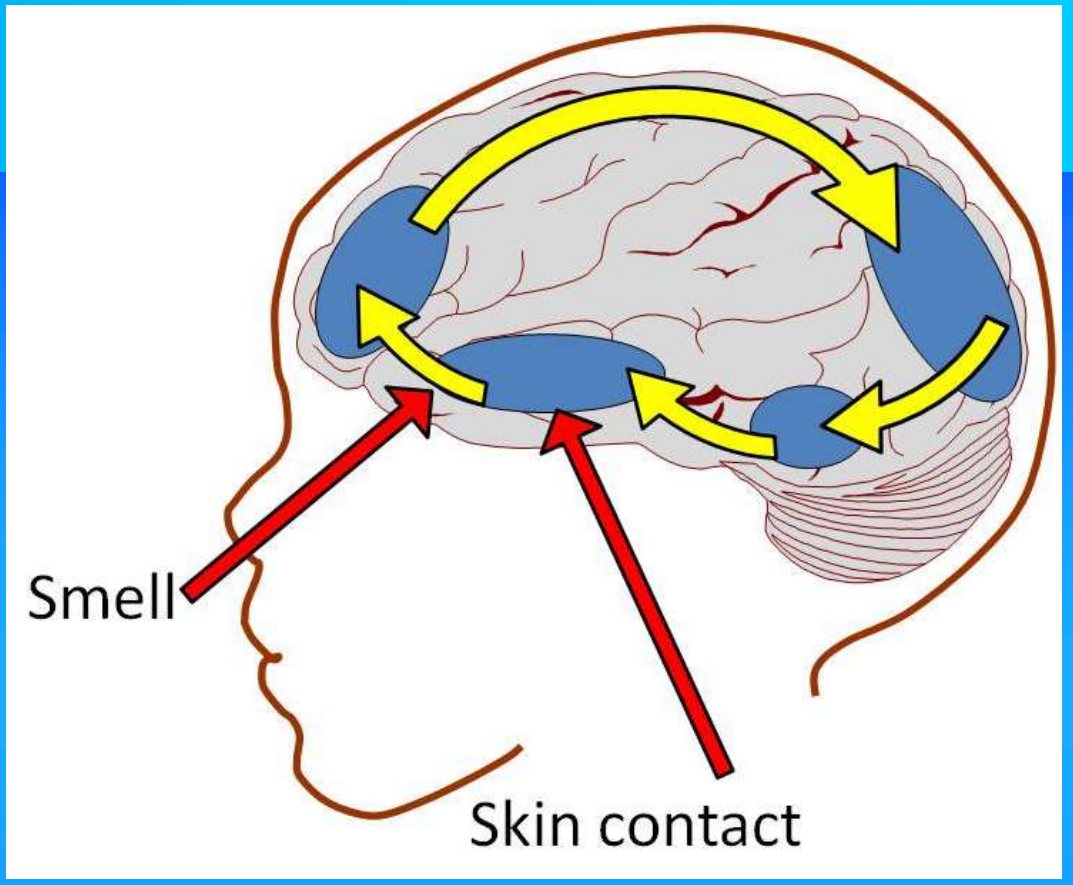
NURTURESCIENCE





AT BIRTH,

the brain has TWO CRITICAL SENSORY NEEDS:

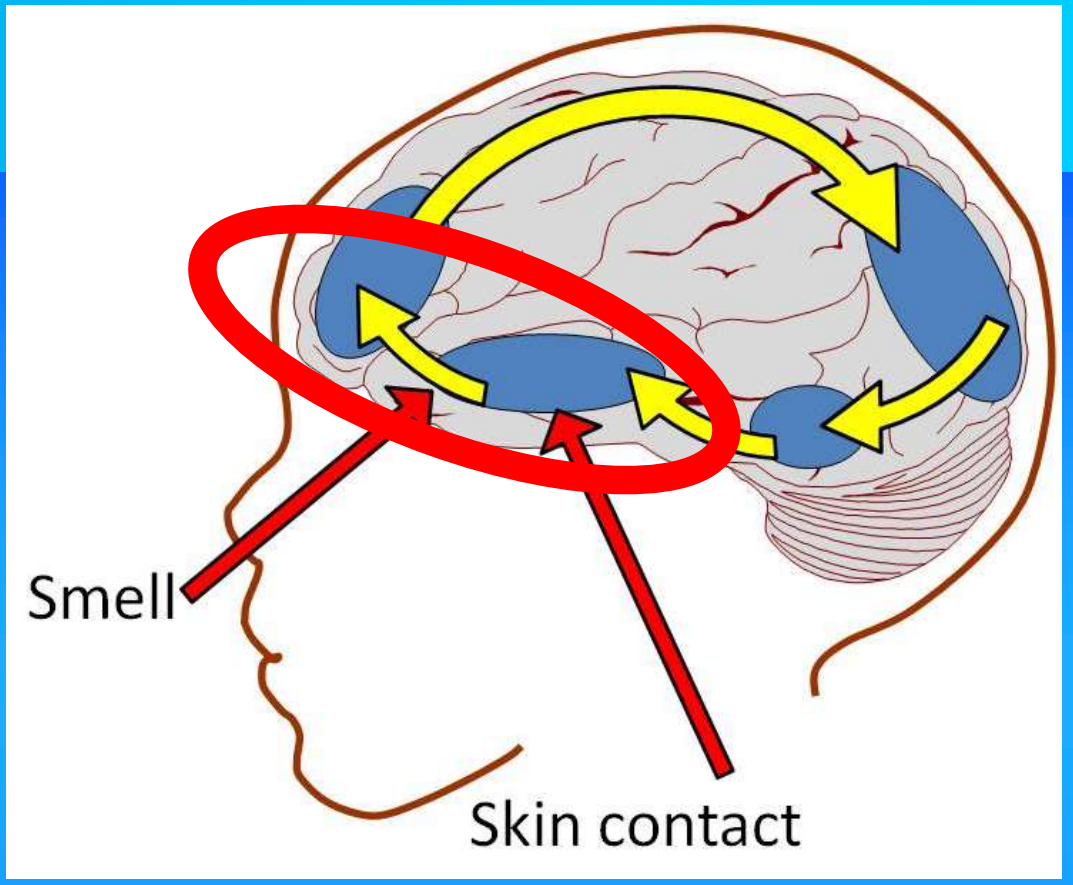


SMELL & CONTACT

connect direct to the amygdala

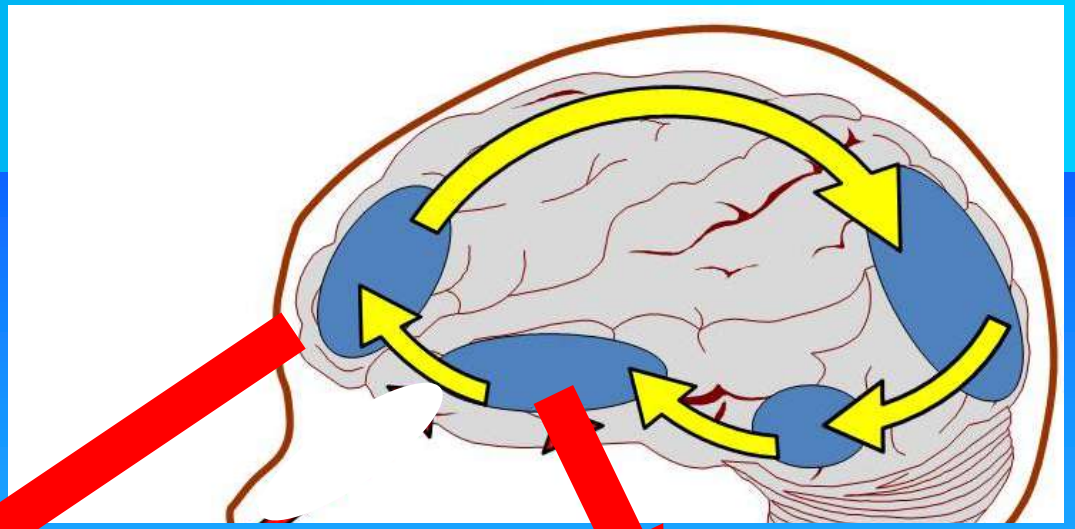
THE NEWBORN BRAIN

SKIN-TO-SKIN CONTACT fires and wires



the amygdala-prefronto-orbital cortical pathway (PFOC)

Schore 2001



Prefrontal cortex
Executive function

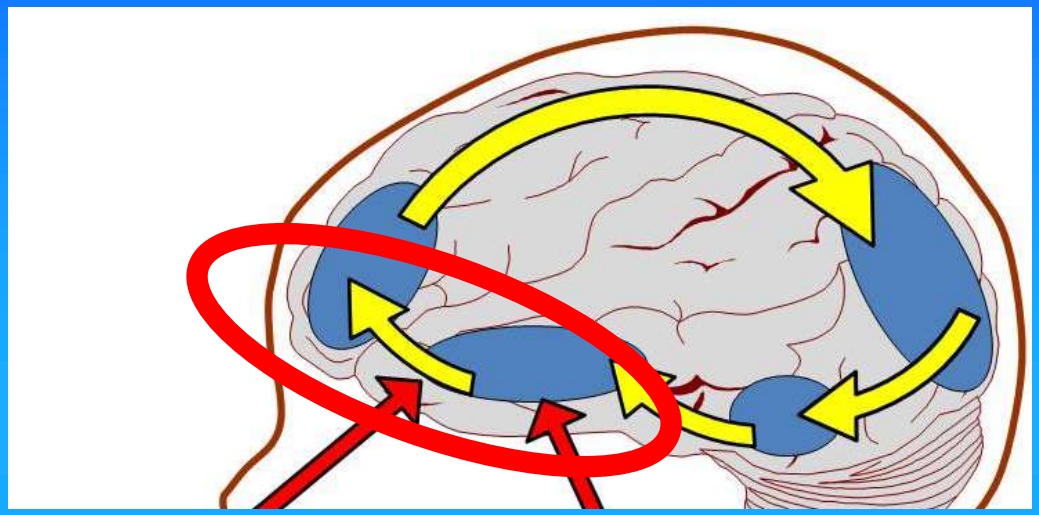
AMYGDALA:
Emotional Processing Unit

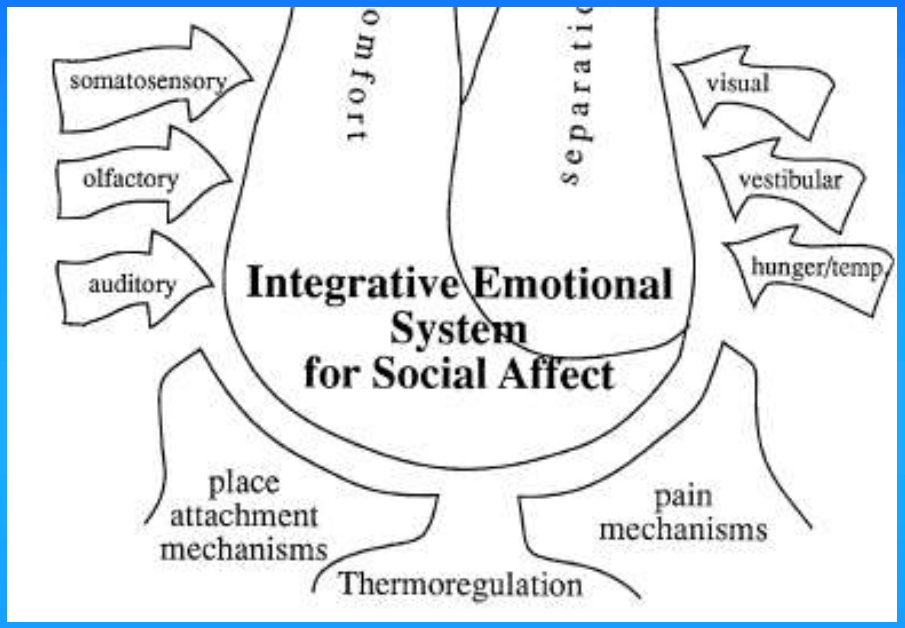
CPU

SOCIAL and EMOTIONAL INTELLIGENCE

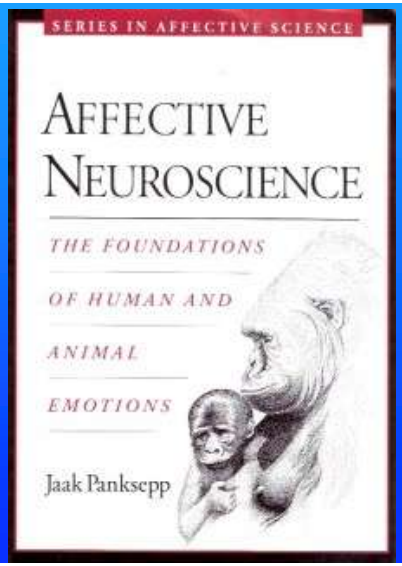
SOCIAL INTELLIGENCE

EMOTIONAL INTELLIGENCE





Behavioural activation system reward-based (dopamine)



Early Experience Alters Brain Function and Structure

Heidelise Als, PhD*; Frank H. Duffy, MD‡; Gloria B. M[illegible]nulty, PhD*; Michael J. Rivkin, MD*‡§;

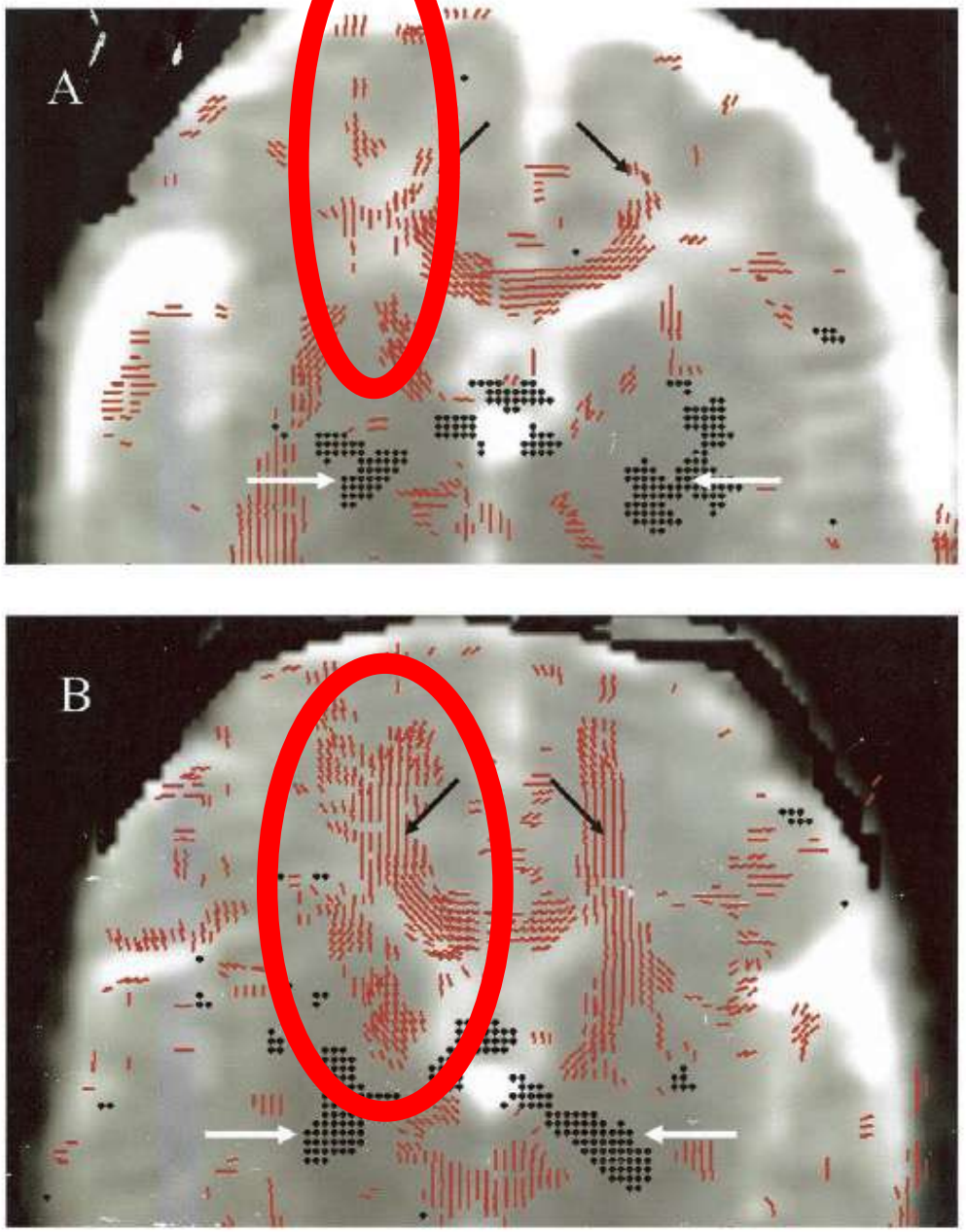


Fig 3. MRI DTI: comparison of control and experimental group infants at 2 weeks' corrected age. Shown are examples of diffusion tensor maps from identical axial slices through the frontal lobes of a representative control group (A) and an experimental group (B) infant obtained at 2 weeks' corrected age. In each example, the principal eigenvectors (shown in red and black) overlie the apparent diffusion coefficient (ADC) map to show anisotropy in white matter. The red lines denote eigenvectors located within the plane of the image, and the black dots indicate eigenvectors oriented mostly perpendicular to the image plane. The ratio of E1/E3 has been used as a threshold to show only eigenvectors at those voxels where E1/E3 exceeds a threshold value of 1.3 in both images. Note the greater anisotropy of white matter found in the experimental infant (B) as compared with the control infant (A) at the posterior limbs of the internal capsule (white arrows) and the frontal white matter adjacent to the corpus callosum (black arrows). The greater anisotropy found in the experimental infant (B) suggests more advanced white matter development in these regions as compared with white matter found in the control infant (A).

Als 2004

Clinical Neurophysiology - Accepted August 17, 2013

Electroencephalographic activity of preterm infants is increased by Family Nurture Intervention: a Randomized Controlled Trial in the NICU

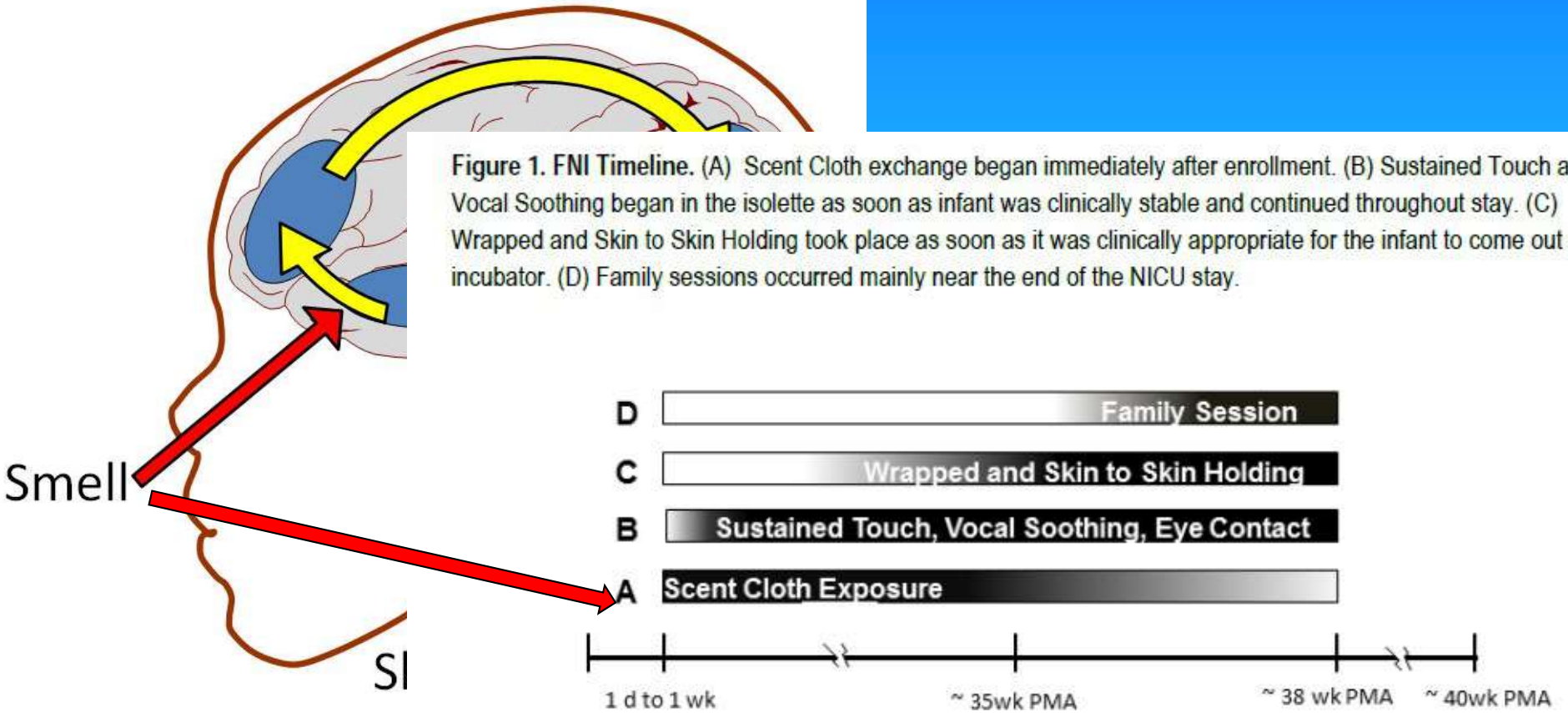
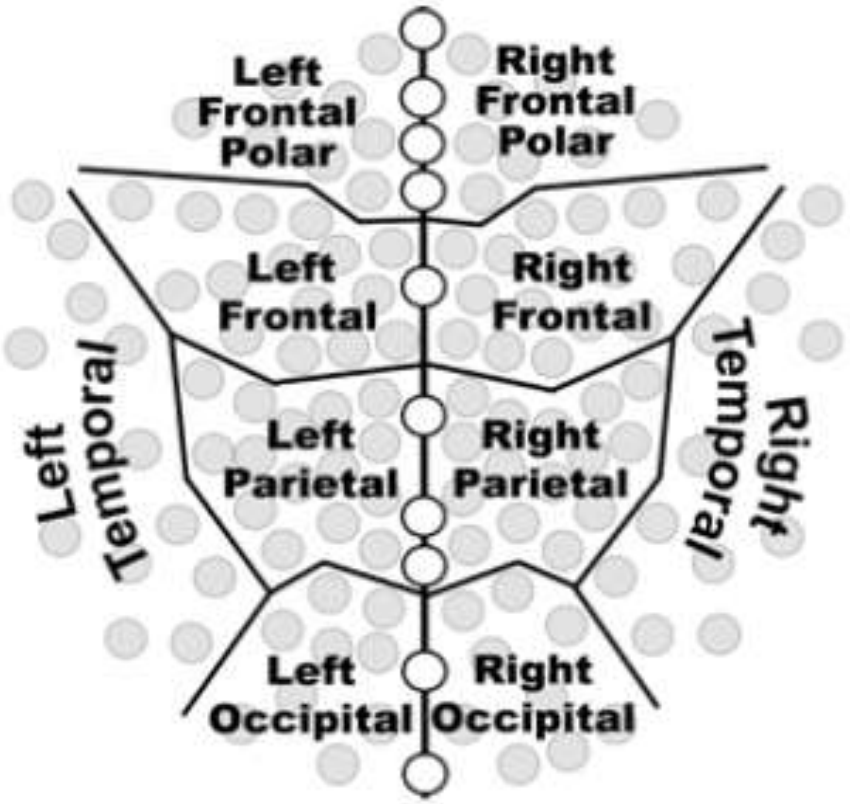
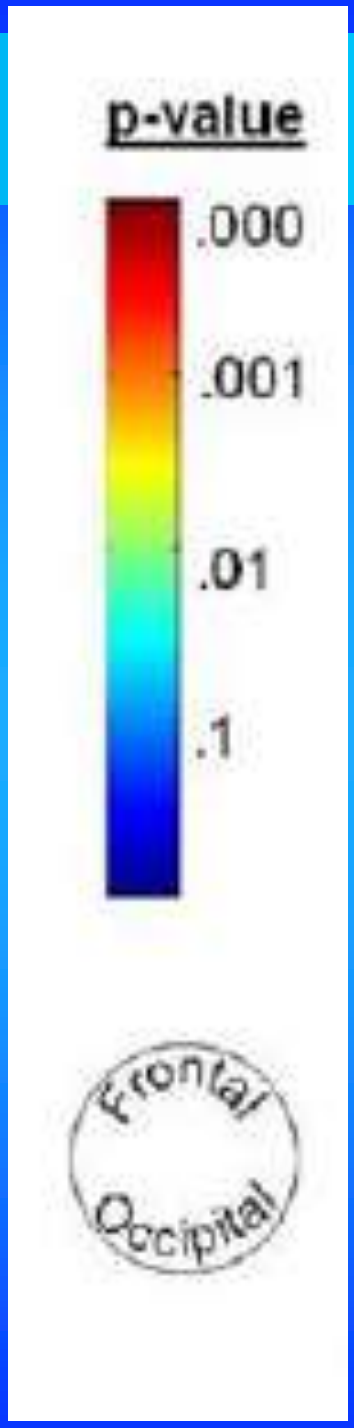


Figure 1. FNI Timeline. (A) Scent Cloth exchange began immediately after enrollment. (B) Sustained Touch and Vocal Soothing began in the isolette as soon as infant was clinically stable and continued throughout stay. (C) Wrapped and Skin to Skin Holding took place as soon as it was clinically appropriate for the infant to come out of the incubator. (D) Family sessions occurred mainly near the end of the NICU stay.

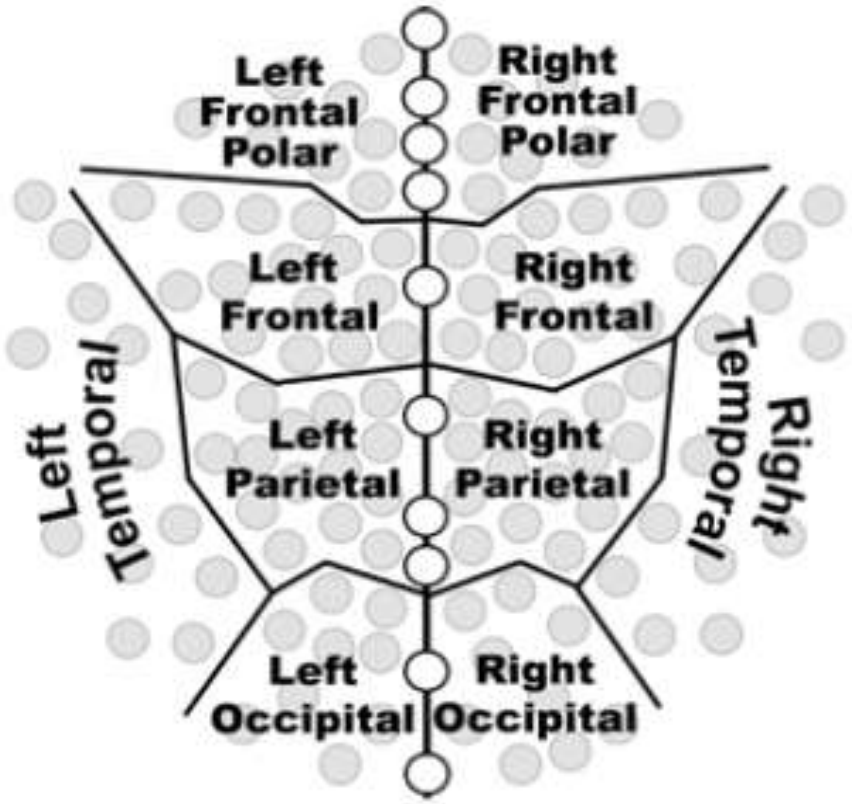
Welch 2013

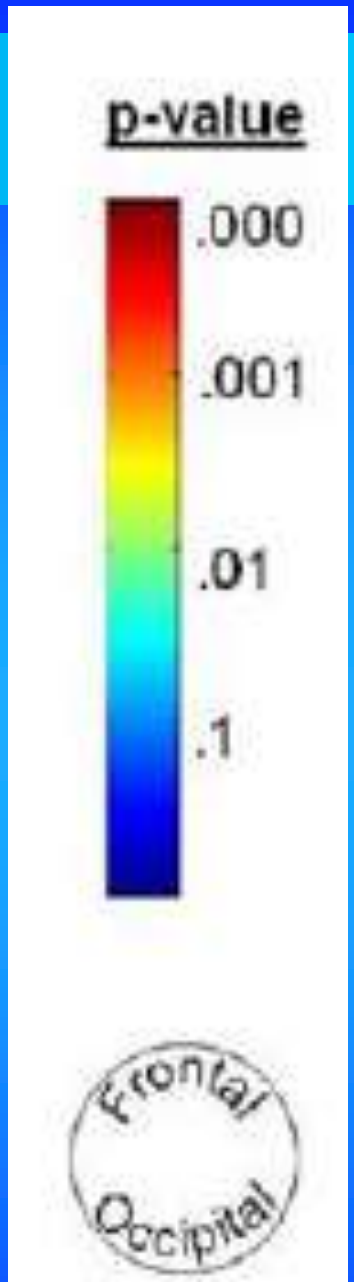
EG net. The 124 electrodes in the E
nalyses of the study. Note 10 midline





EG net. The 124 electrodes in the E
nalyses of the study. Note 10 midline

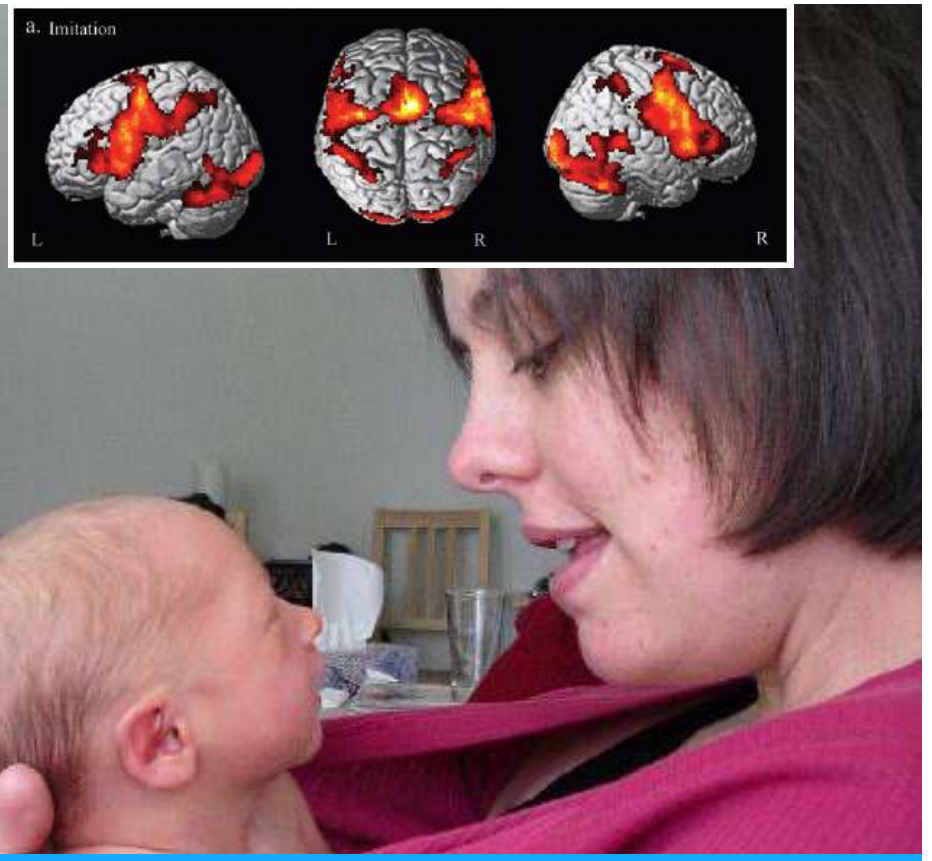




Cerebral Cortex May 2009;19:1124-1133
doi:10.1093/cercor/bhn153
Advance Access publication September 11, 2008

Neural Basis of Maternal Communication and Emotional Expression Processing during Infant Preverbal Stage

infant self. Sixteen mothers underwent functional magnetic resonance imaging while observing and imitating faces of their own child and those of someone else's child. We found that the mirror neuron system, the insula and amygdala were more active during emotional expressions, that this circuit is engaged to a greater extent when interacting with one's own child, and that it is correlated with maternal reflective function (a measure of empathy). We also found, by comparing single emotions with each



As predicted, imitation and observation of facial expressions elicited activation of fronto-parietal mirror areas (vPMC-IFG-pars opercularis and IPL), STS, anterior insula, and amygdala.

Therefore, our results are in keeping with the *simulation theory* (or motor theory of empathy), according to which empathy is generated by inner imitation of actions of others

Lenzi 2009

Kerstin
Uvnas-Moberg

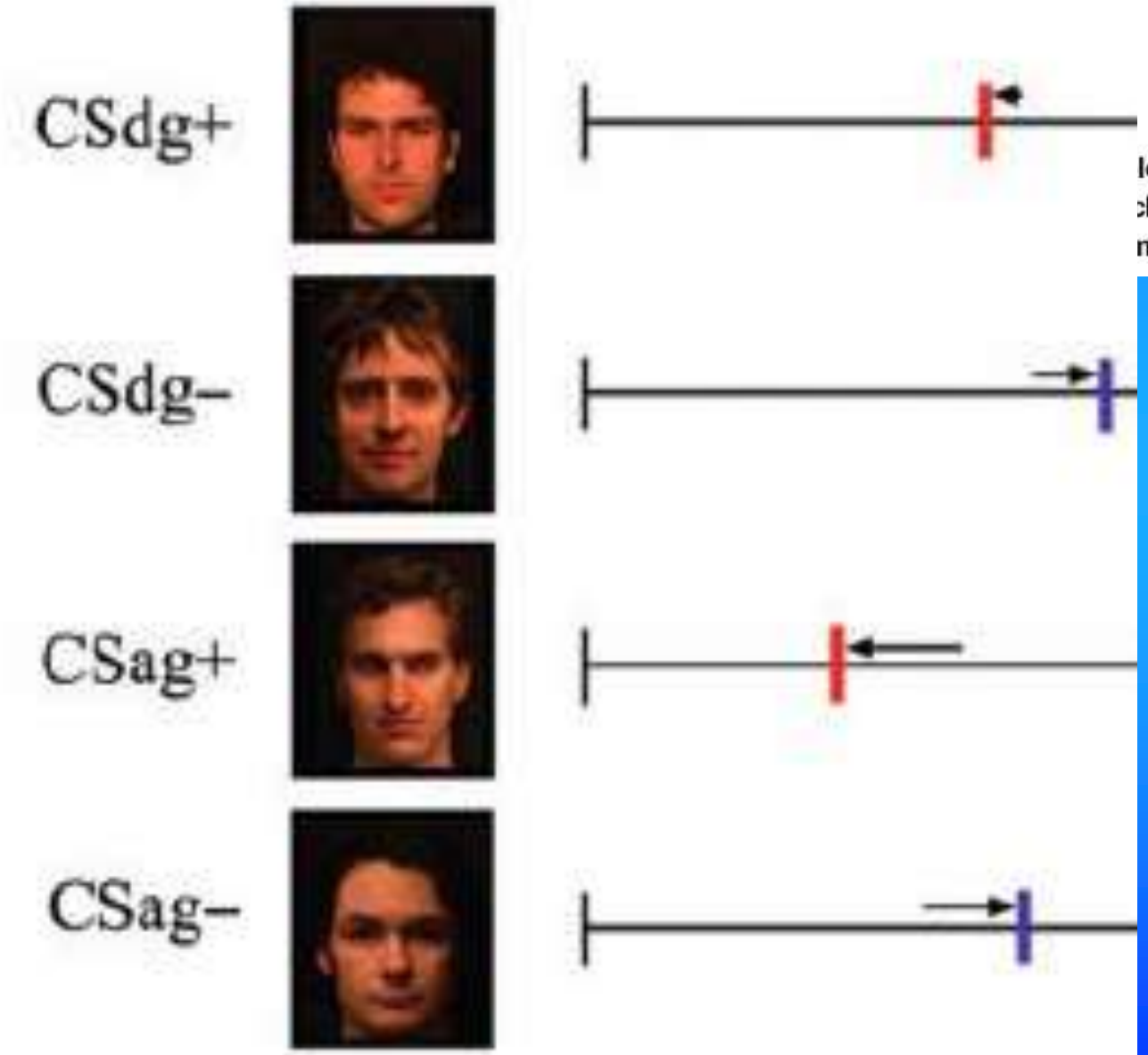
Ross 2009

In humans, oxytocin increases gaze to the eye region of human faces and enhances interpersonal trust and the ability to infer the emotions of others from facial cues.

Learning affective values for faces is expressed in amygdala and fusiform gyrus

Predrag Petrovic, Raffael Kali
Wellcome Trust Centre for Neuroima

To monitor the environment for soc
and to a high degree shaped by res
these evaluations are constructed i

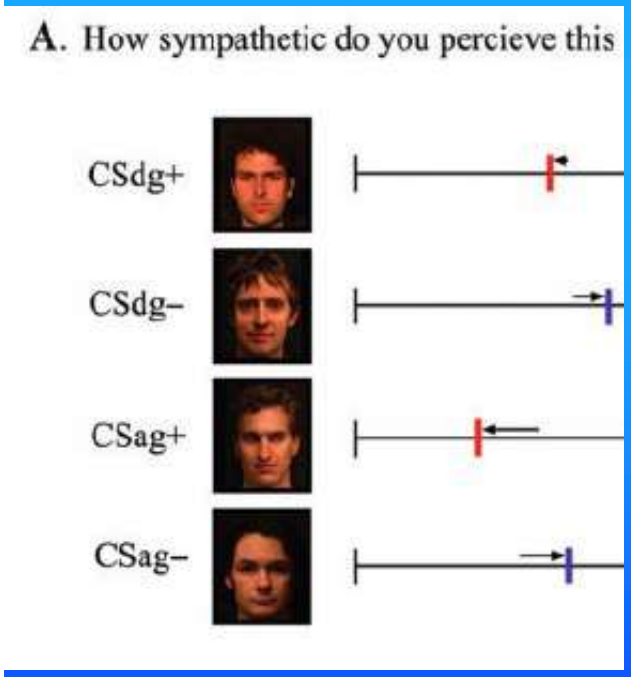


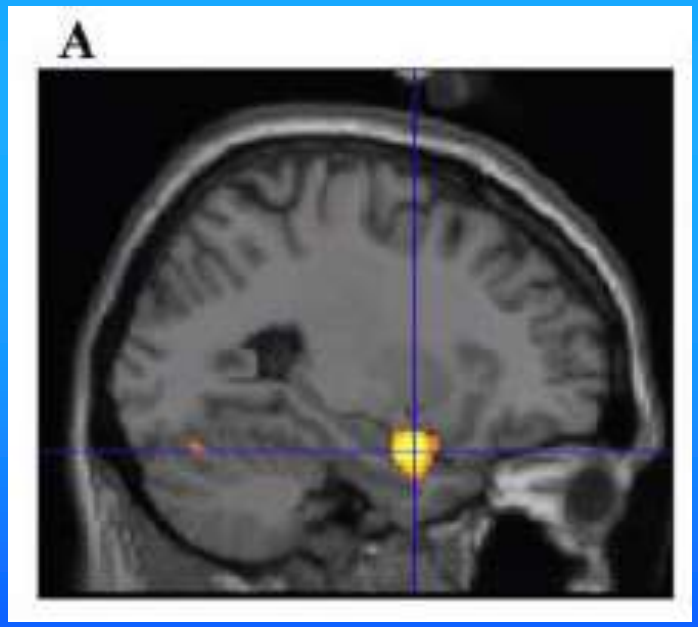
Petrovic 2008

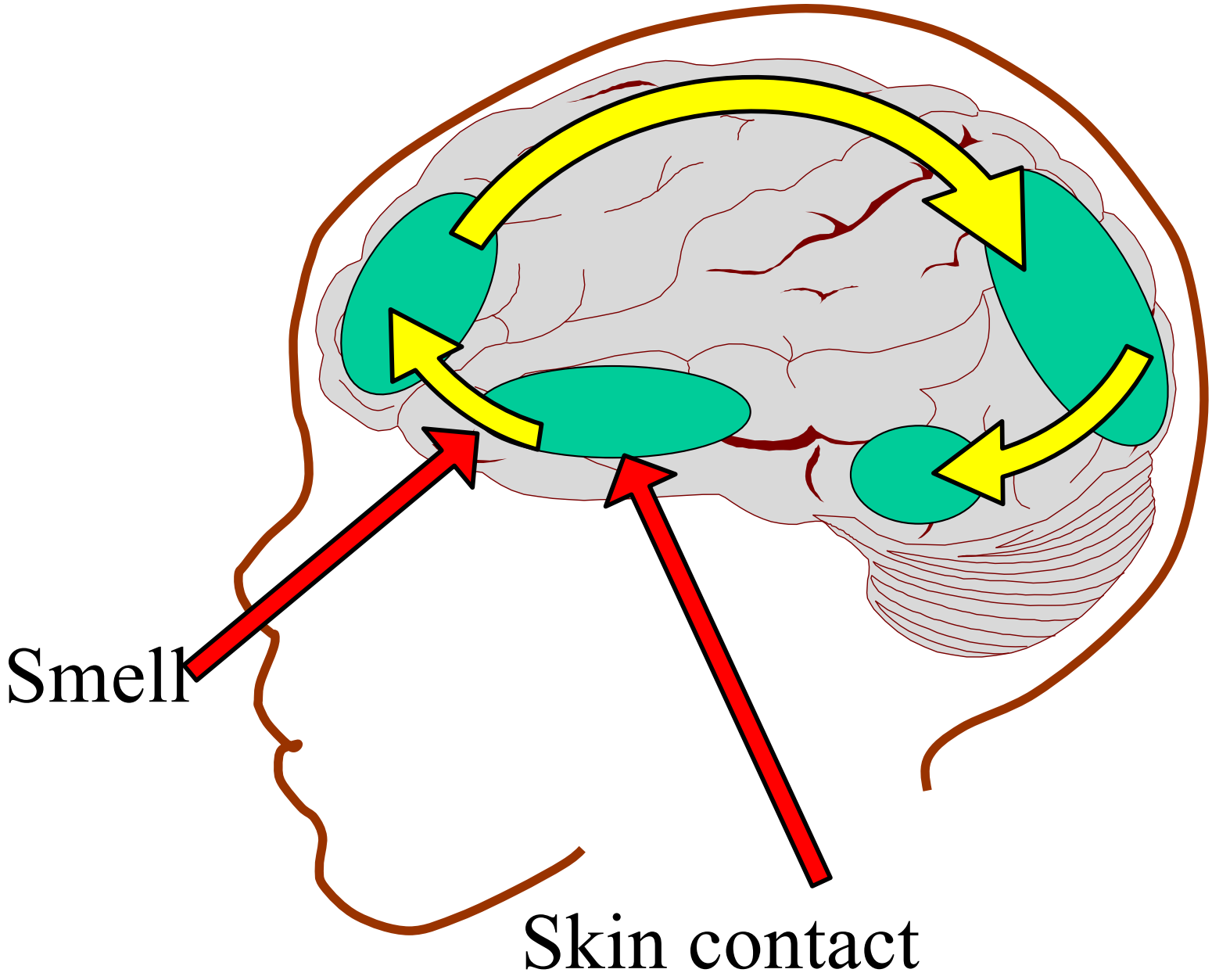
Learning affective values for faces is expressed in amygdala and fusiform gyrus

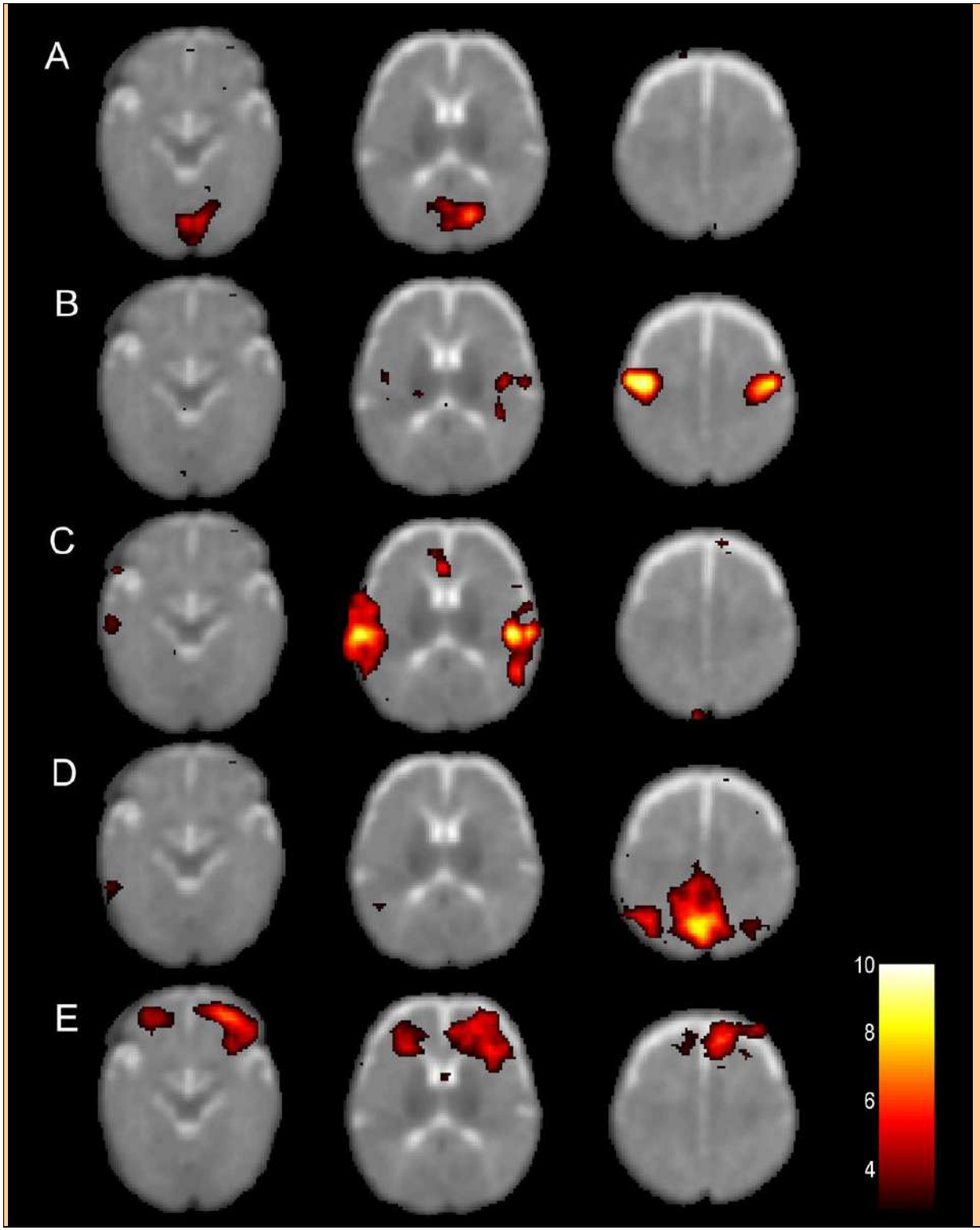
Predrag Petrovic, Raffael Kalisch, Mathias Pessiglione, Tania Singer, and Raymond J. Dolan
Wellcome Trust Centre for Neuroimaging, University College of London, 12 Queen Square, London, WC1N 3BG, UK

To monitor the environment for social threat humans must build affective evaluations of others. These evaluations are malleable and to a high degree shaped by responses engendered by specific social encounters. The precise neuronal mechanism by which these evaluations are constructed is poorly understood. We tested a hypothesis that conjoint activity in amygdala and fusiform



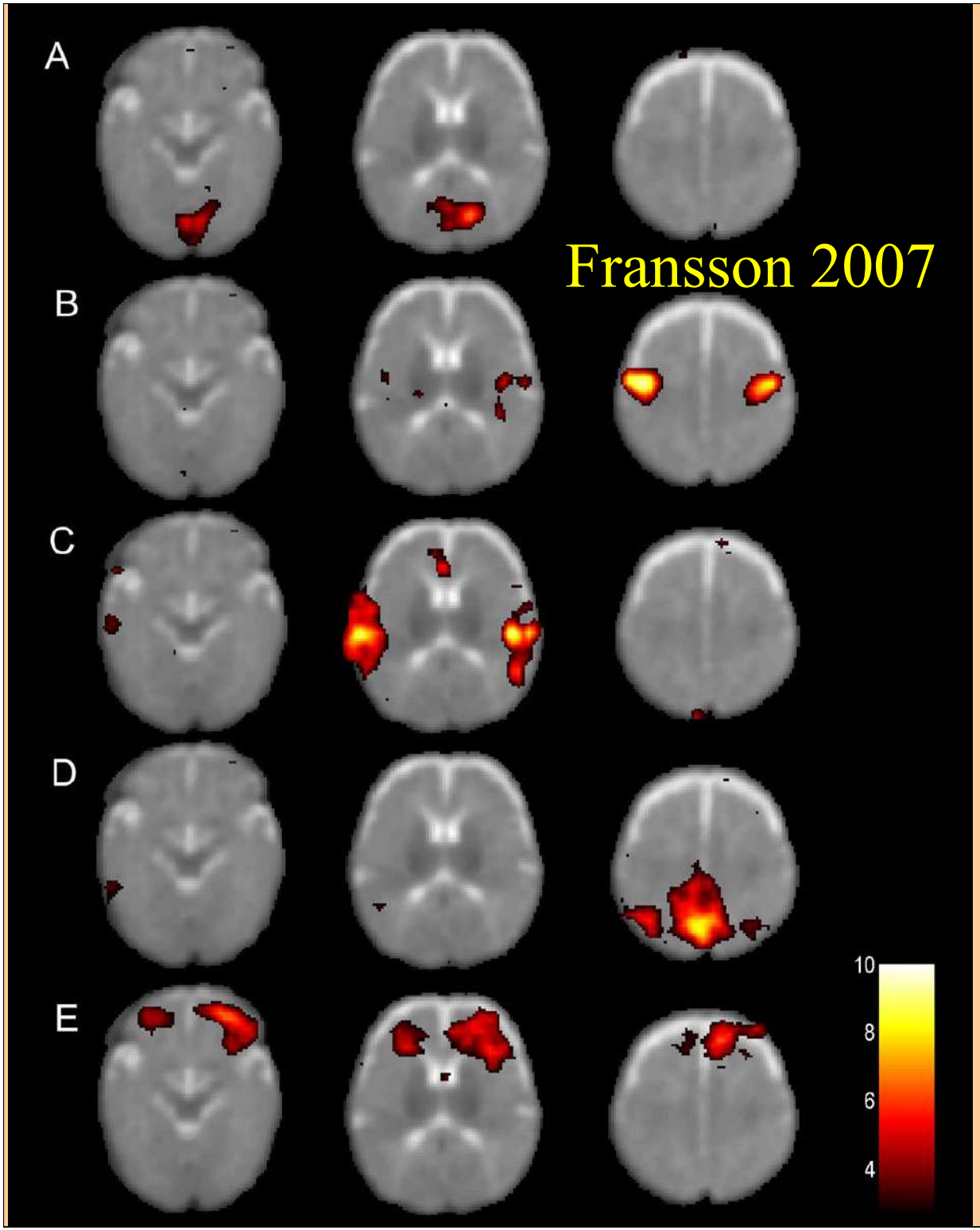



Smell
Skin contact



The infant brain is not blank! Resting activity - "stream of consciousness"

Fransson 2007



A primary visual areas,

B somatosensory motor cortex

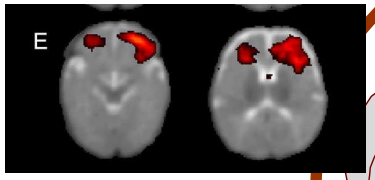
C primary auditory cortex

D parietal cortex & cerebellum

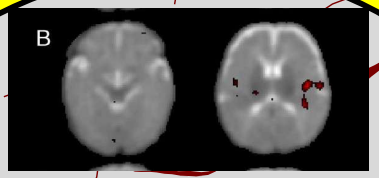
E m l anterior pre-frontal cortex

OXYTOCIN

EMOTION CONTROL CENTRE

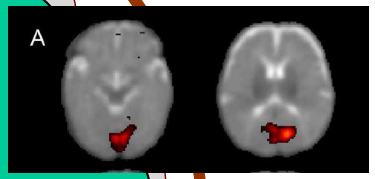


E prefrontal

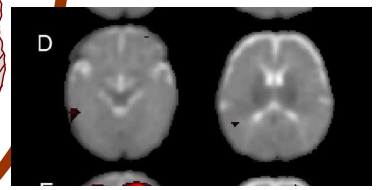


B somatosensory

A primary visual

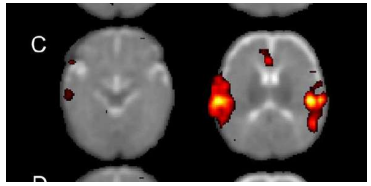


D parietal & cerebellum



Smell

FACE RECOGNITION CENTRE

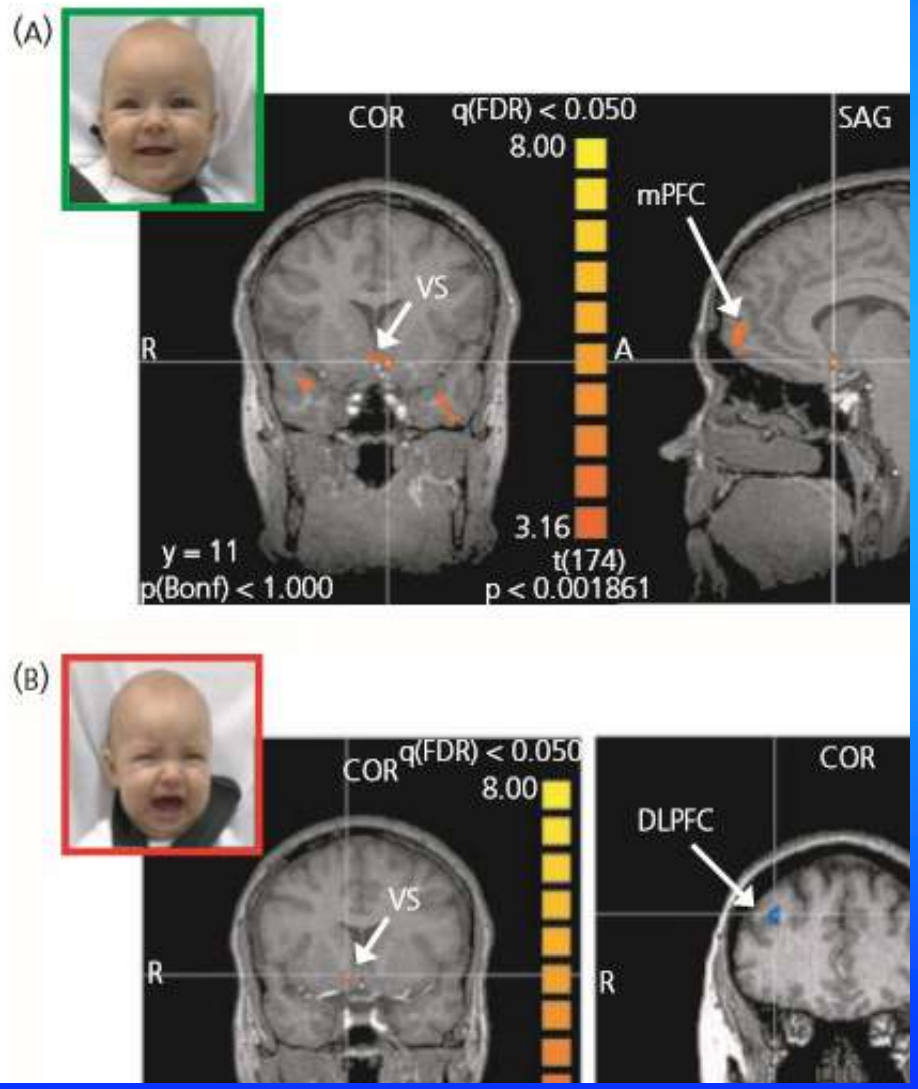


C primary auditory

Skin contact

How oxytocin and dopamine connect

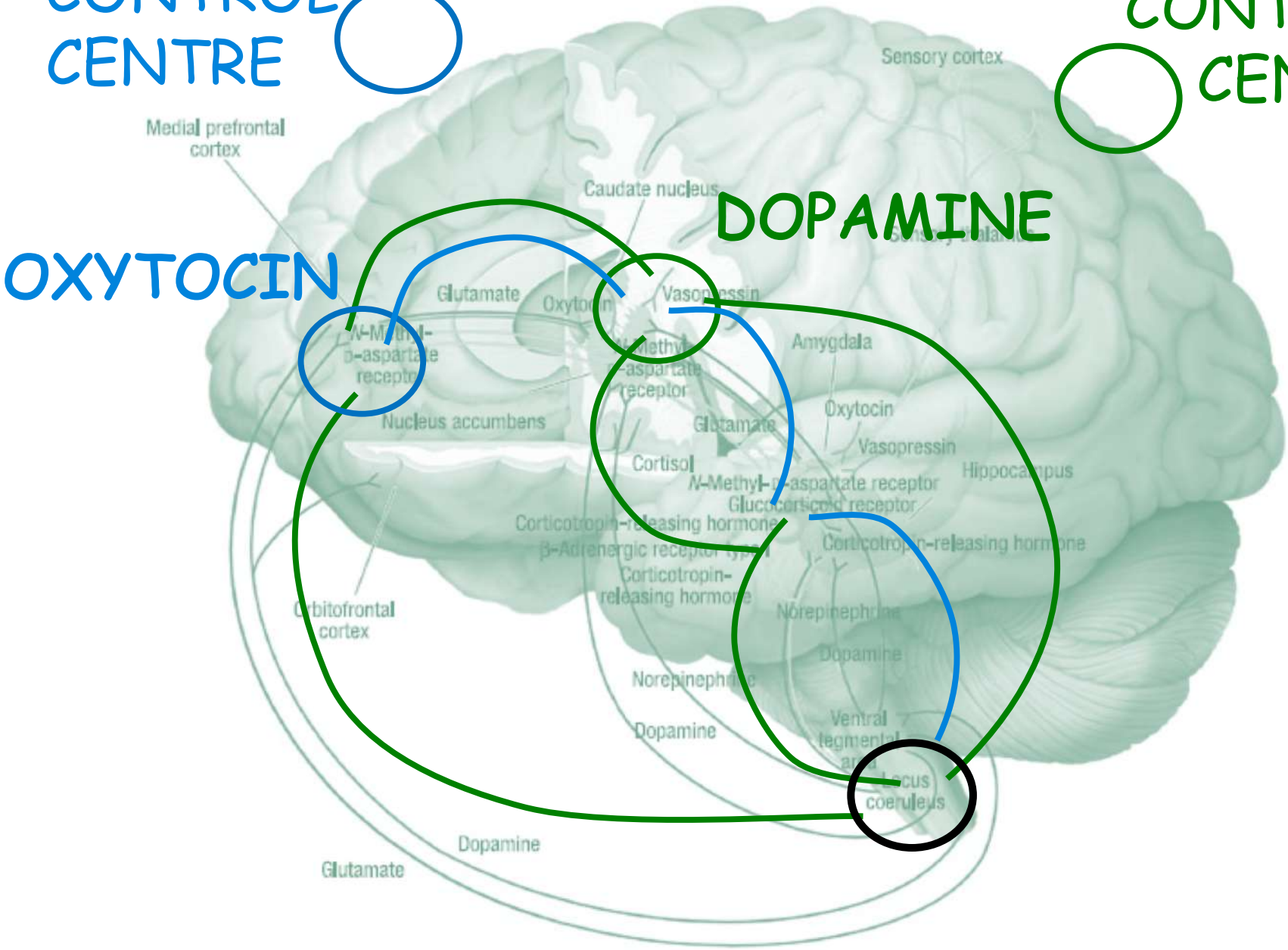
From animal studies, we learn that oxytocinergic circuits are directly linked with the mesocorticolimbic dopamine pathway, with oxytocinergic neurones projecting from the hypothalamic PVN and MPOA to both the VTA and the VS (Fig. 3). The strength of these connections is associated with levels of maternal caregiving behav-



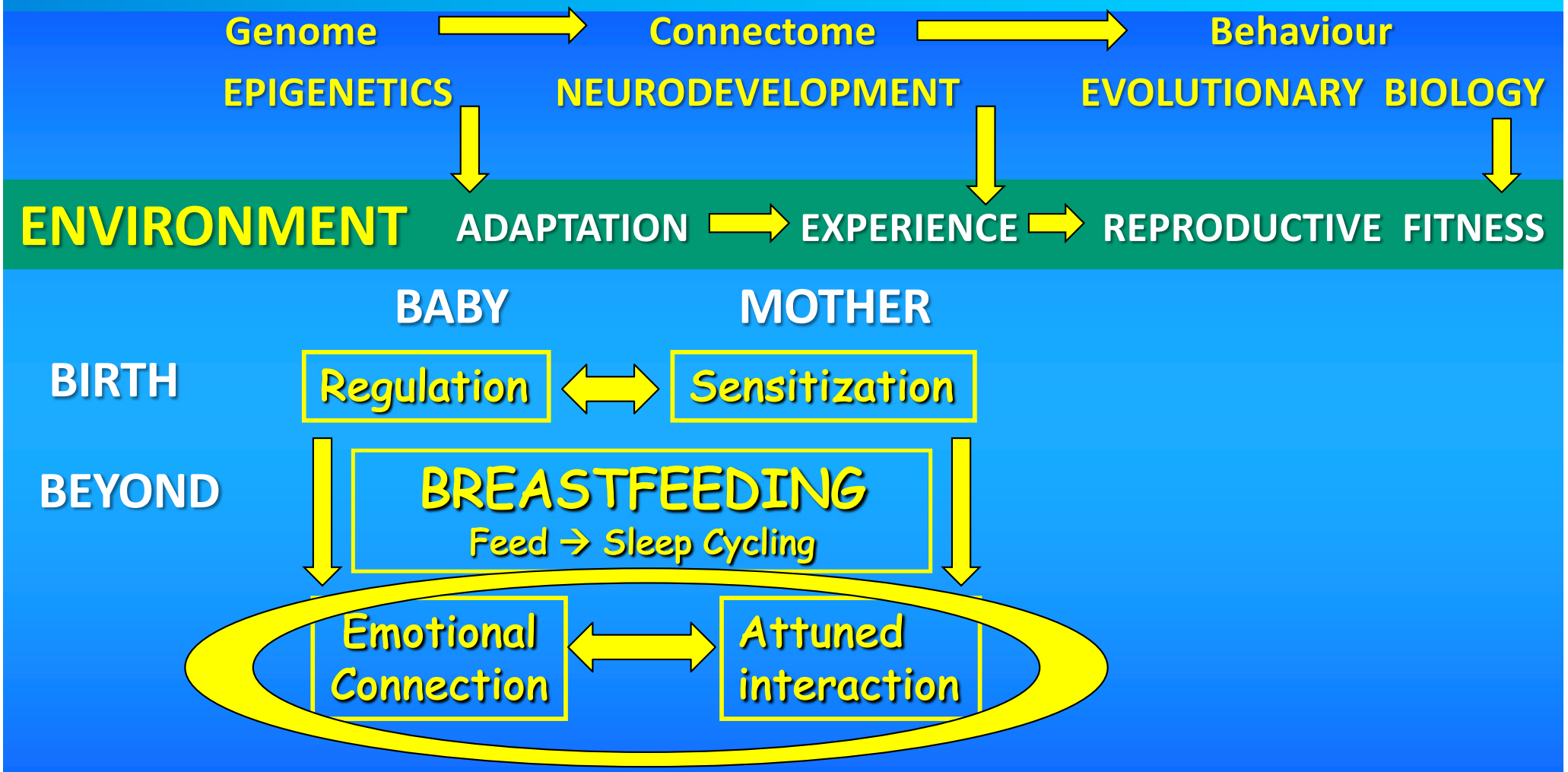
… infant cues - suckling, vocalisation and tactile stimulation - stimulate **OXYTOCIN** release in the hypothalamus, which may result in the activation of the **DOPAMINE** reward pathway leading to behavioural reinforcement

SOCIAL CONTROL CENTRE

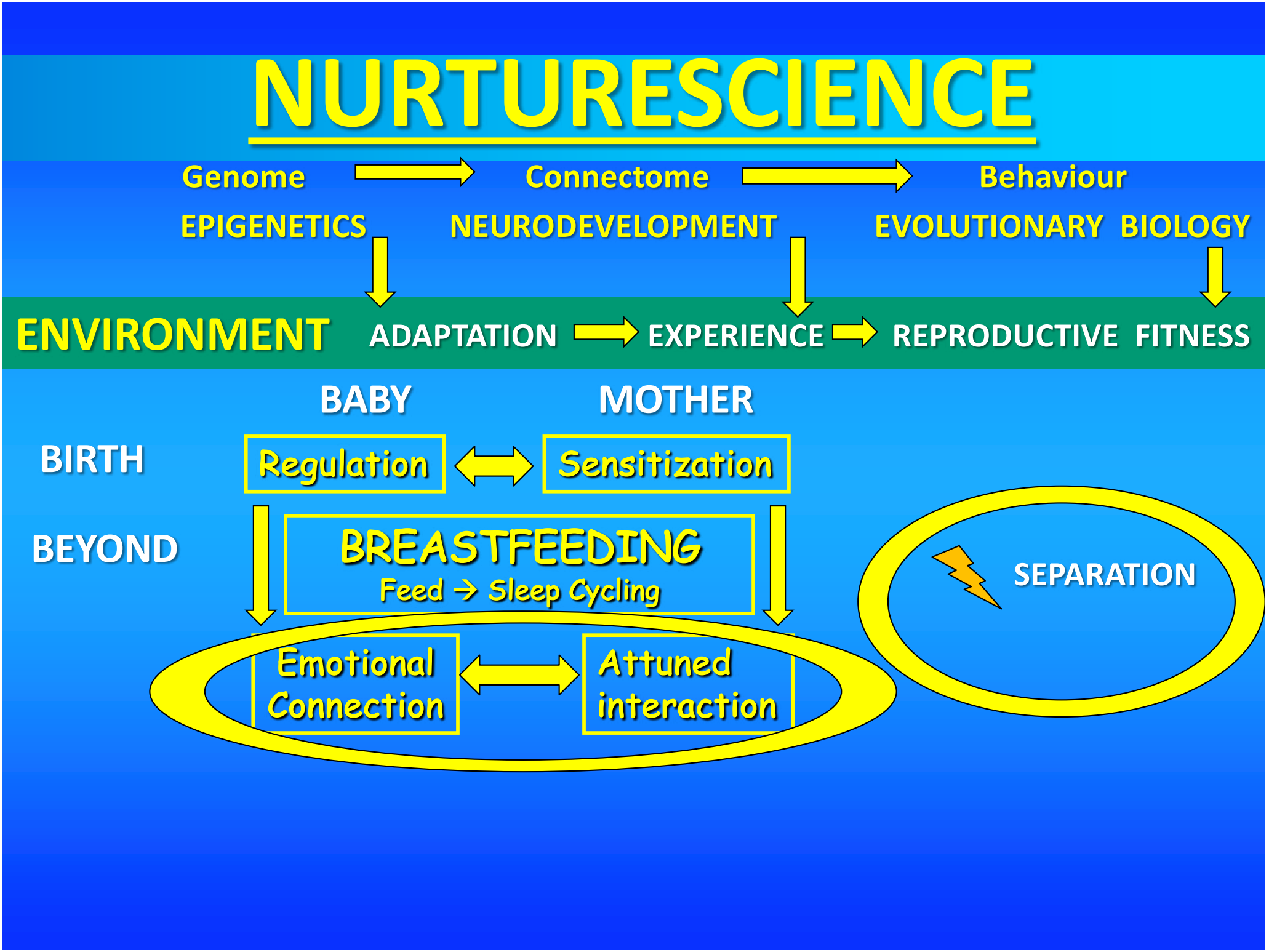
REWARD CONTROL CENTRE



NURTURESCIENCE

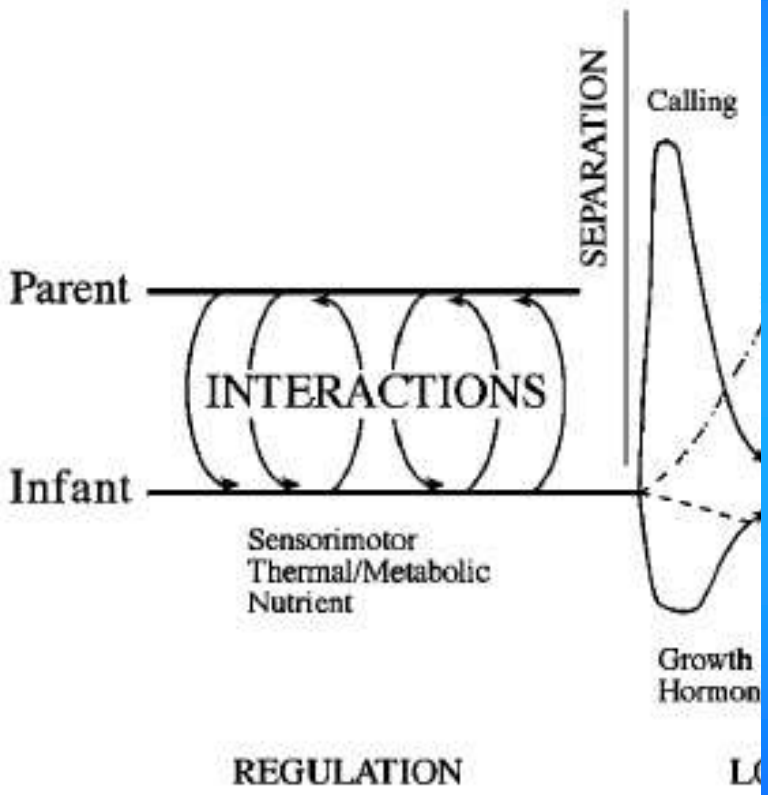


NURTURESCIENCE



WHY IS EARLY MATERNAL SEPARATION STRESSFUL?

SEPARATION



ntation of
he loss of
mother–infant relationship.

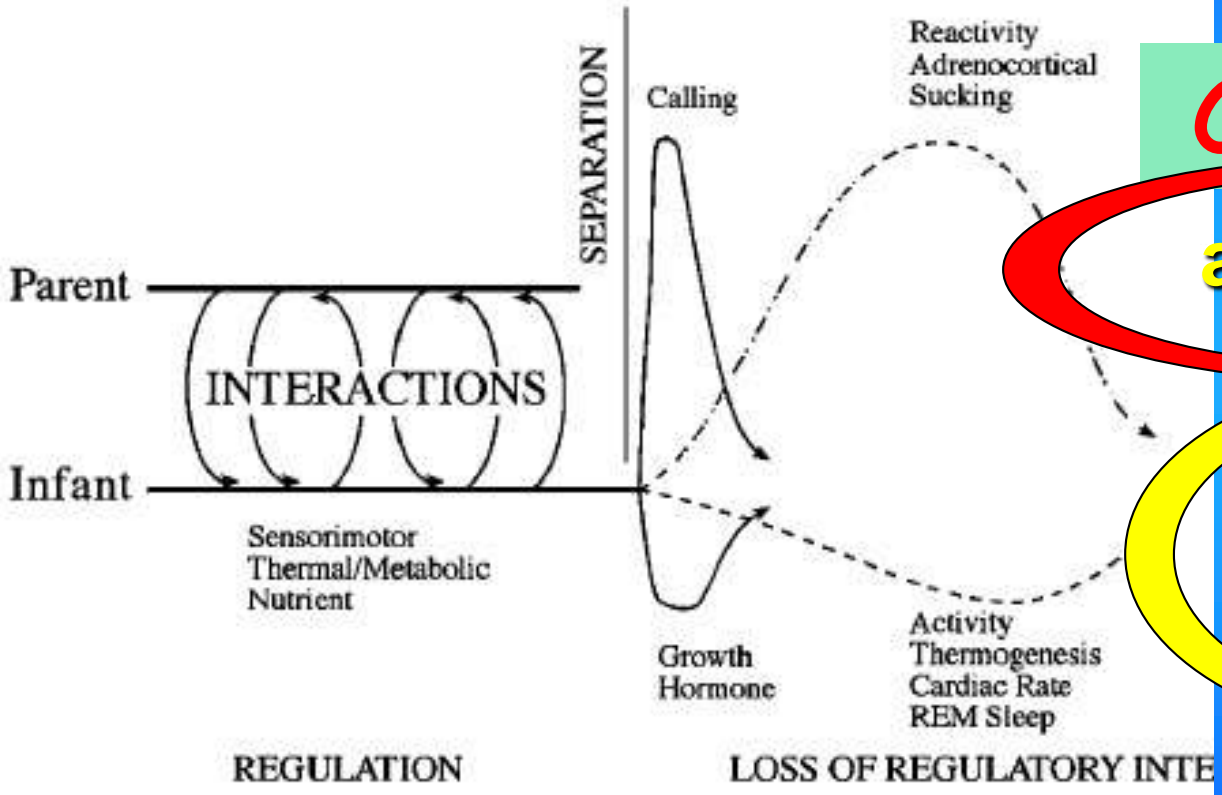
OXYTOCIN

absence

SEPARATION

WHY IS EARLY MATERNAL SEPARATION STRESSFUL?

SEPARATION DYSREGULATES



ntation of the dynamics of ear
he loss of regulatory interactio
mother–infant relationship.

CORTISOL

absence

SEPARATION

Toxic stress

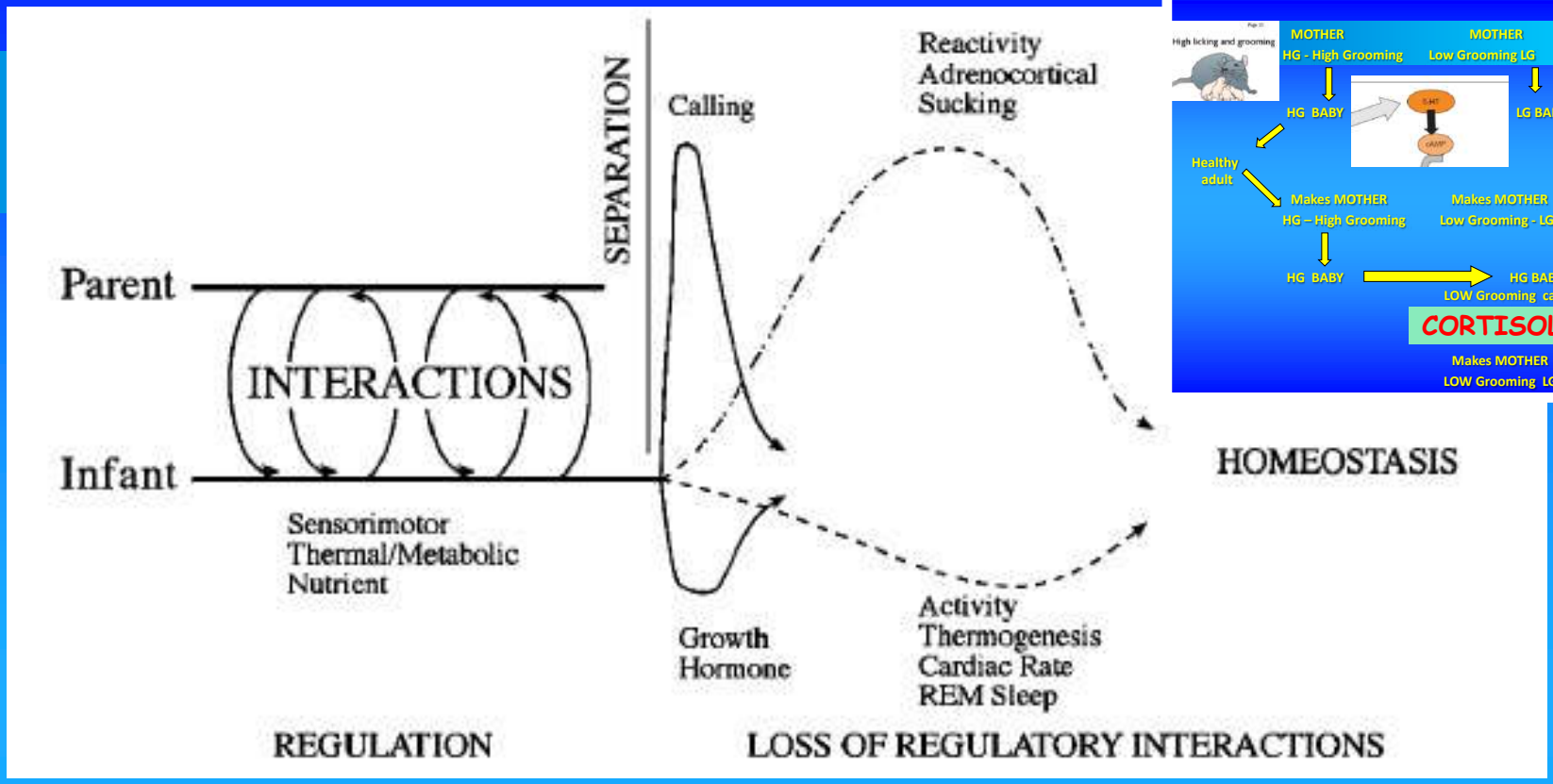
OXYTOCIN

Toxic Stress

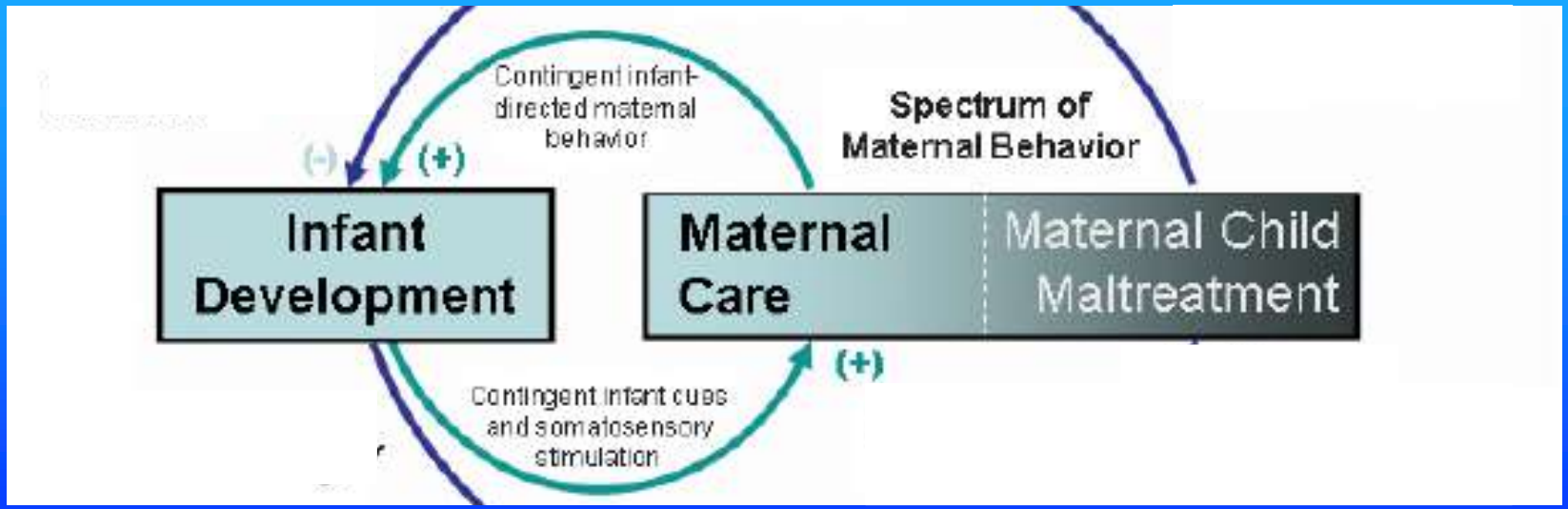
- Strong and prolonged activation of the body's stress management systems in the absence of the buffering protection of adult support.

- Disrupts brain architecture and leads to stress management systems that respond at relatively lower thresholds, thereby increasing the risk of stress-related physical and mental illness.

Slide by: Jack P. Shonkoff, M.D.


SEPARATION
Calling
Reactivity
Adrenocortical
Sucking
Parent
INTERACTIONS
Infant
Sensorimotor
Thermal/Metabolic
Nutrient
Growth
Hormone
Activity
Thermogenesis
Cardiac Rate
REM Sleep
HOMEOSTASIS
REGULATION
LOSS OF REGULATORY INTERACTIONS

MOTHER
HG - High Grooming
MOTHER
Low Grooming LG
HG BABY
LG BABY
Healthy
adult
UNHEALTHY
adult
Makes MOTHER
HG – High Grooming
Makes MOTHER
Low Grooming - LG
HG BABY
HG BABY
LOW Grooming care
CORTISOL
UNHEALTHY
adult
Makes MOTHER
LOW Grooming LG

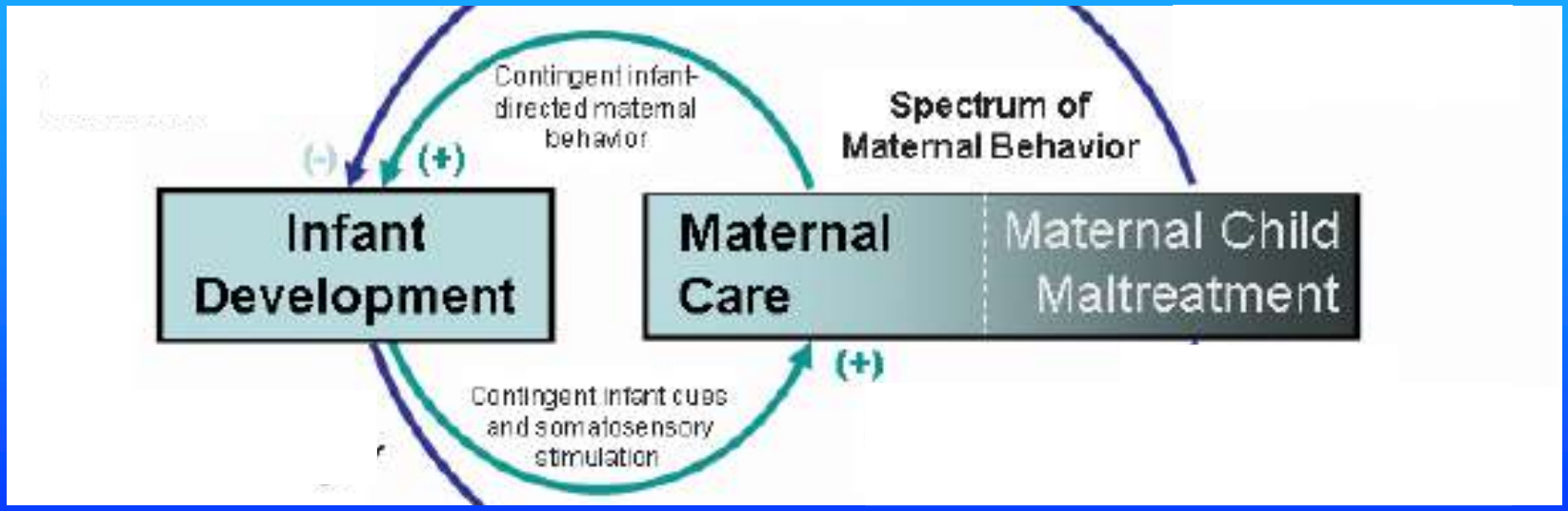

Contingent infant-directed maternal behavior
(-)
(+)
Spectrum of
Maternal Behavior
Infant
Development
Maternal
Care
Maternal Child
Maltreatment
(+)
Contingent infant cues and somatosensory stimulation

Journal of Child Psychology and Psychiatry 48:3/4 (2007), pp 262–287 doi:10.1111/j.1469-7610.2007.01731.x

Brain basis of early parent–infant interactions: psychology, physiology, and *in vivo* functional neuroimaging studies

James E. Swain,[1] Jeffrey P. Lorberbaum,[2,3] Samet Kose,[3] and Lane Strathearn[4,5]

[1]Child Study Center, Yale University, New Haven, CT, USA; [2]Psychiatry Department, Penn State University – Hershey Medical Center, Hershey, PA, USA; [3]Brain Stimulation Laboratory, Medical University of South Carolina, Charleston, SC, USA; [4]Meyer Center for Developmental Pediatrics, Baylor College of Medicine, Houston, TX, USA; [5]Human Neuroimaging Laboratory, Baylor College of Medicine, Houston, TX, USA



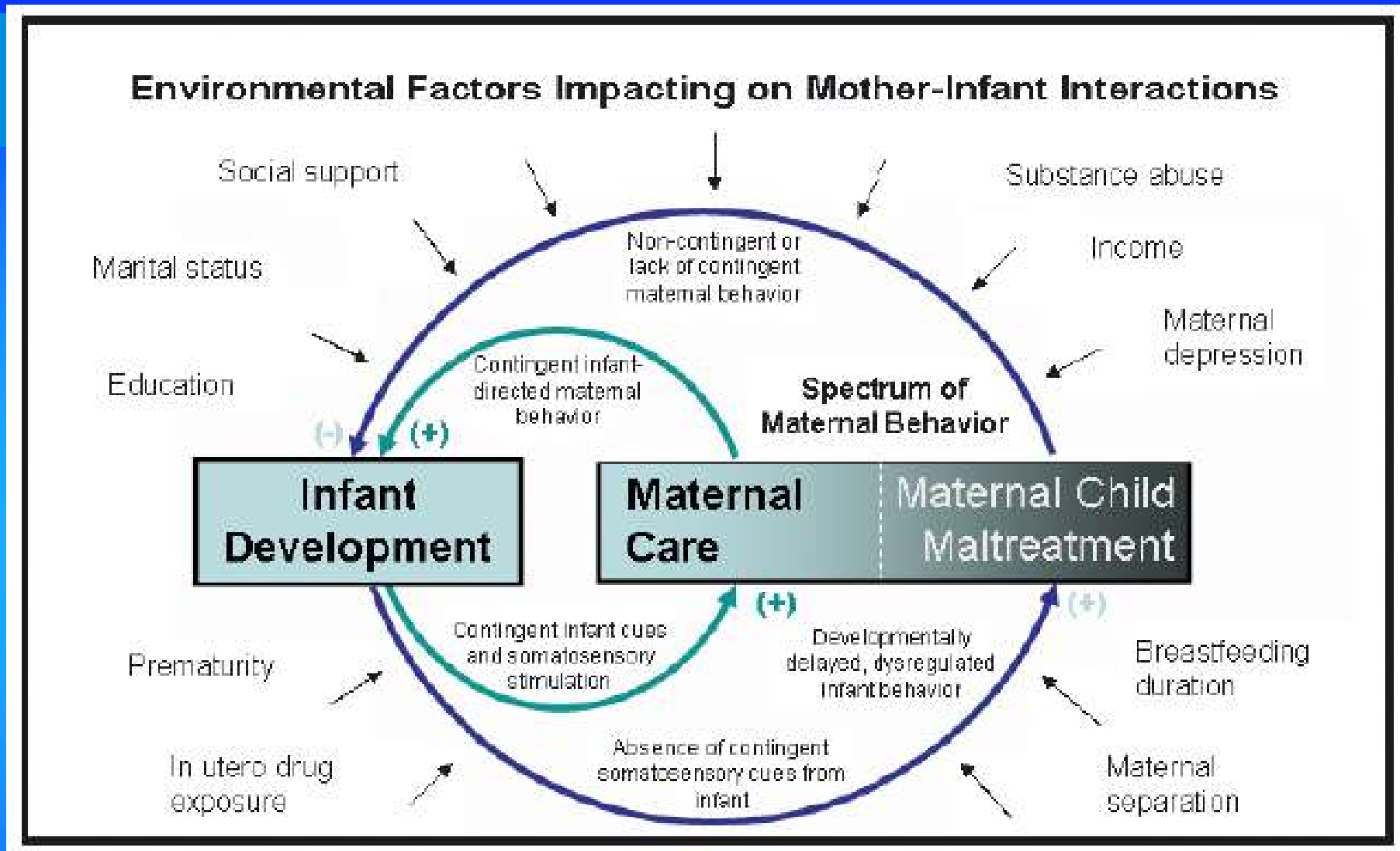
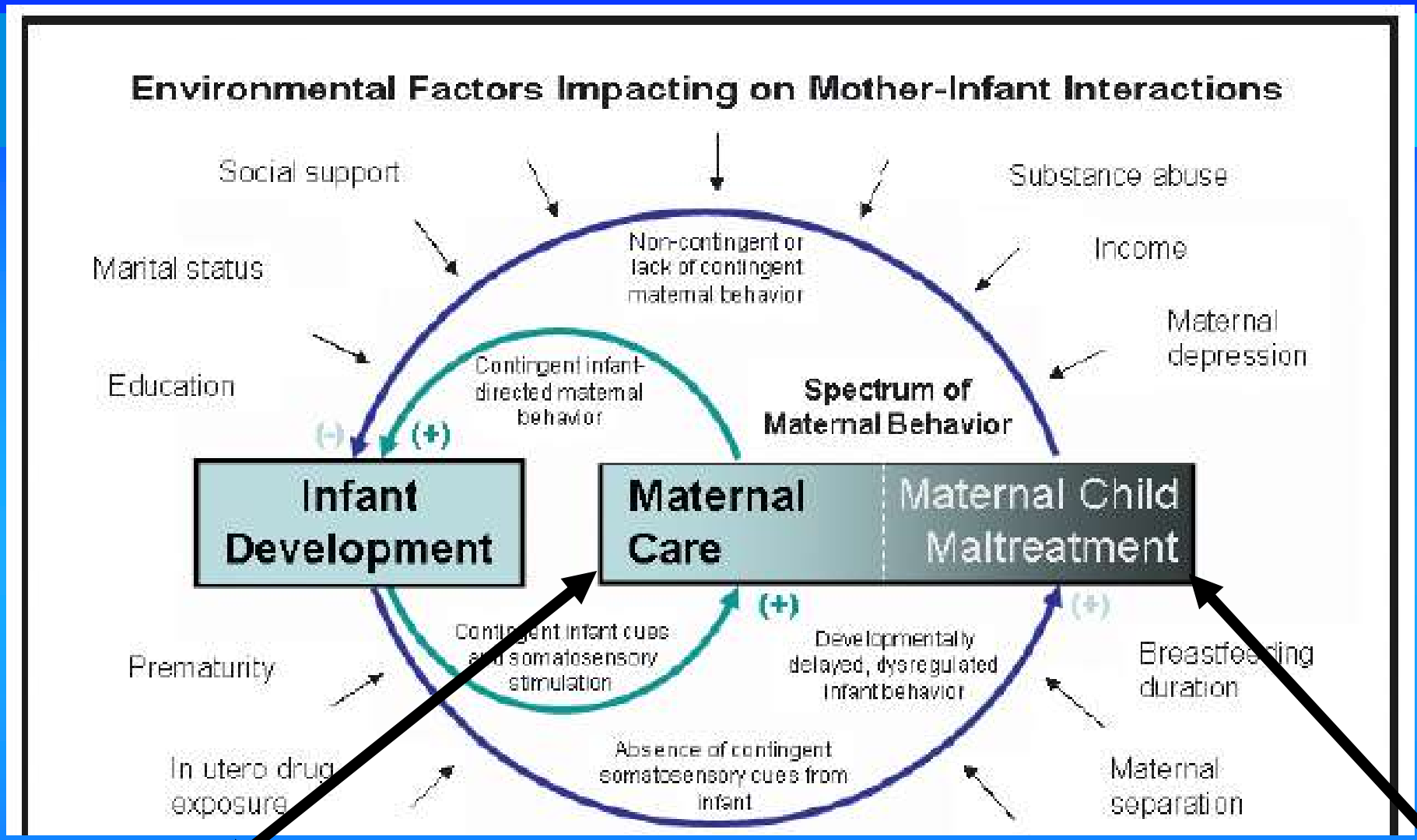


Table 2 Comparison of prominent features of early parent–infant bonding in humans (adapted from Leckman et al., 2006). Early parental love was rated by 21 experts as similar to infant responsiveness except where indicted by an asterisk

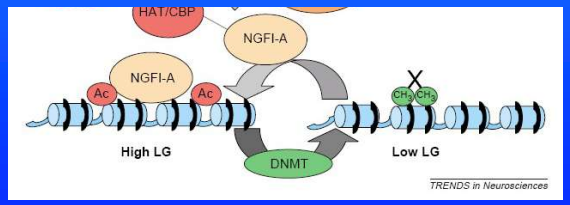
Feature of love	Early parental love	Infant responsiveness
Selective recognition – focus exclusivity	+++/++++	+++
Altered mental state – altered autonomic and behavioral responsivity	+++/++++	+++ [a]



HEALTH

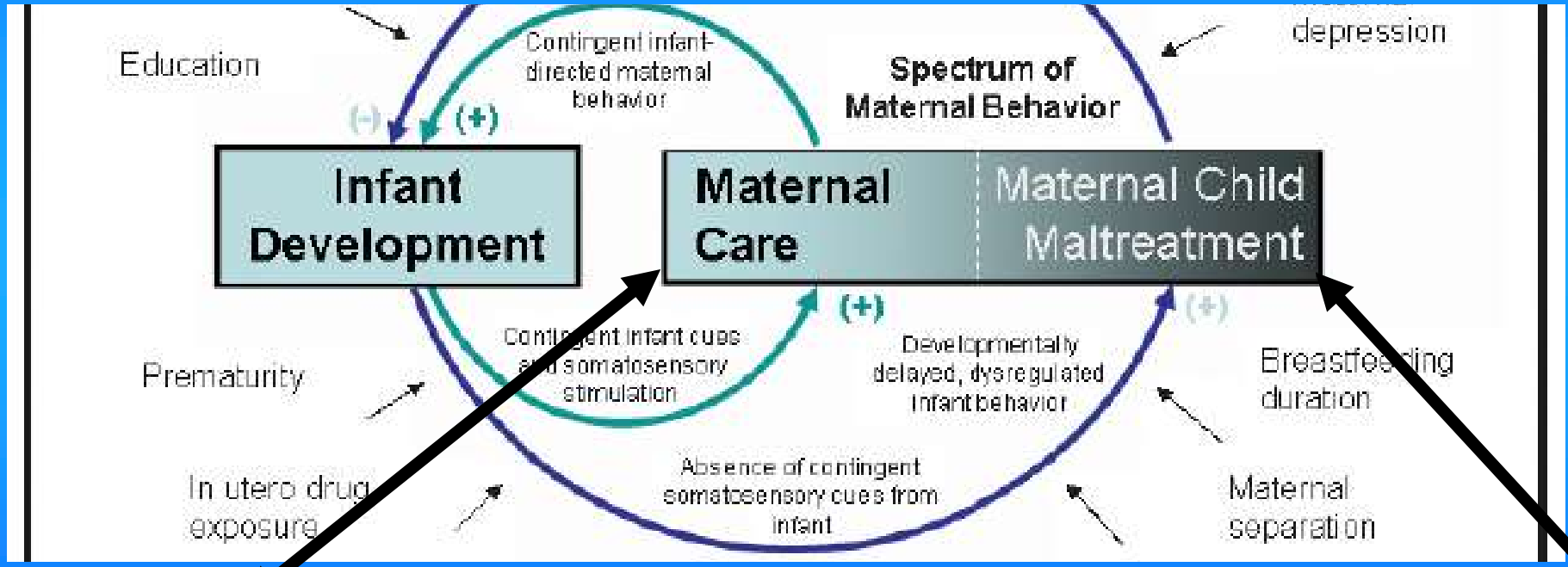
DISEASE

OXYTOCIN



CORTISOL

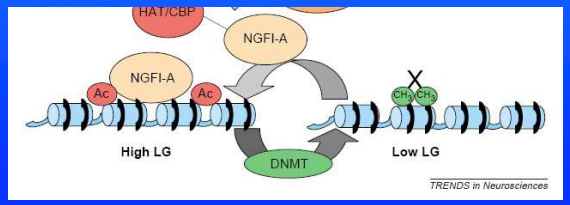
"Womb ecology becomes world ecology."



HEALTH

DISEASE

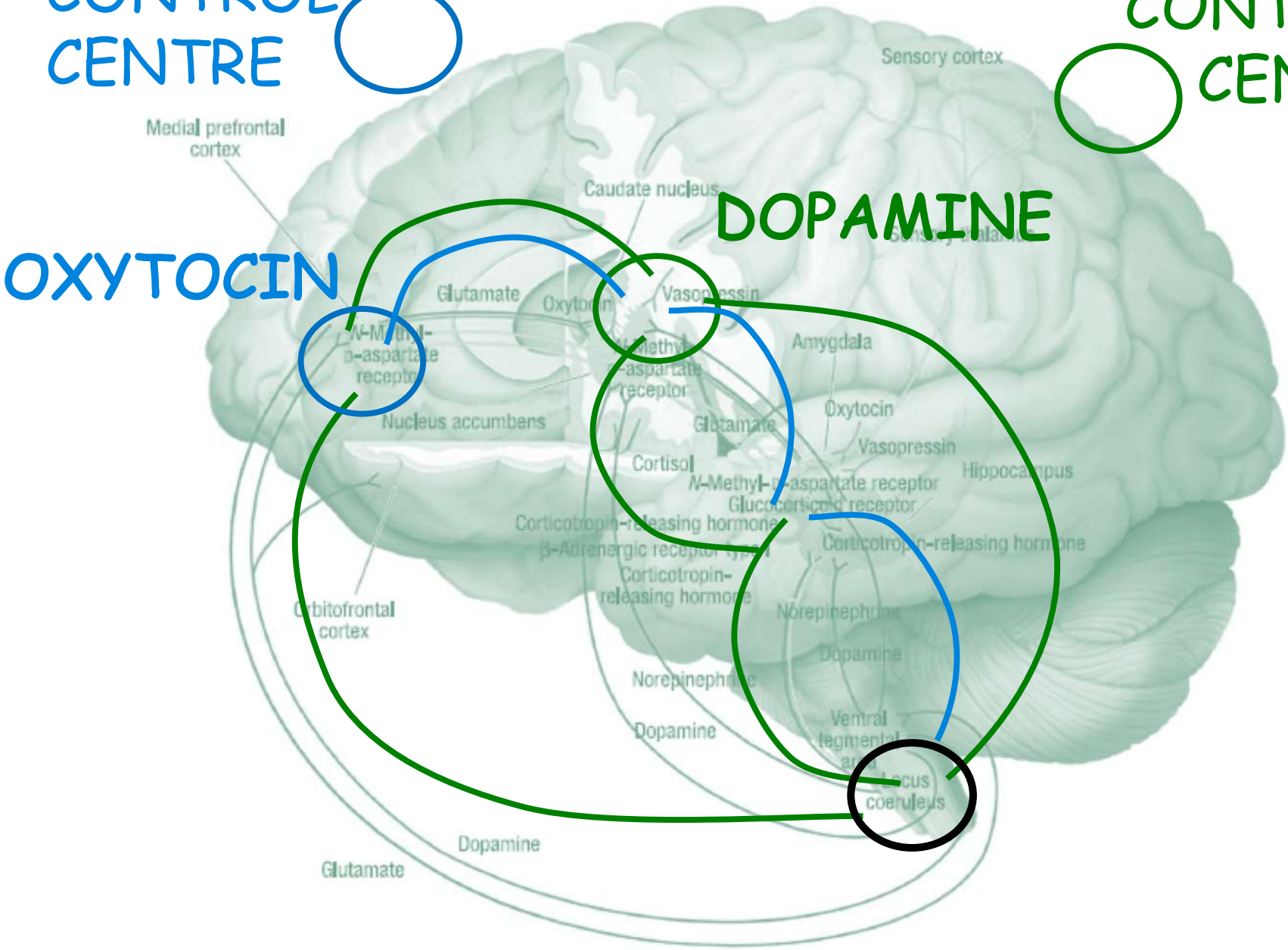
OXYTOCIN

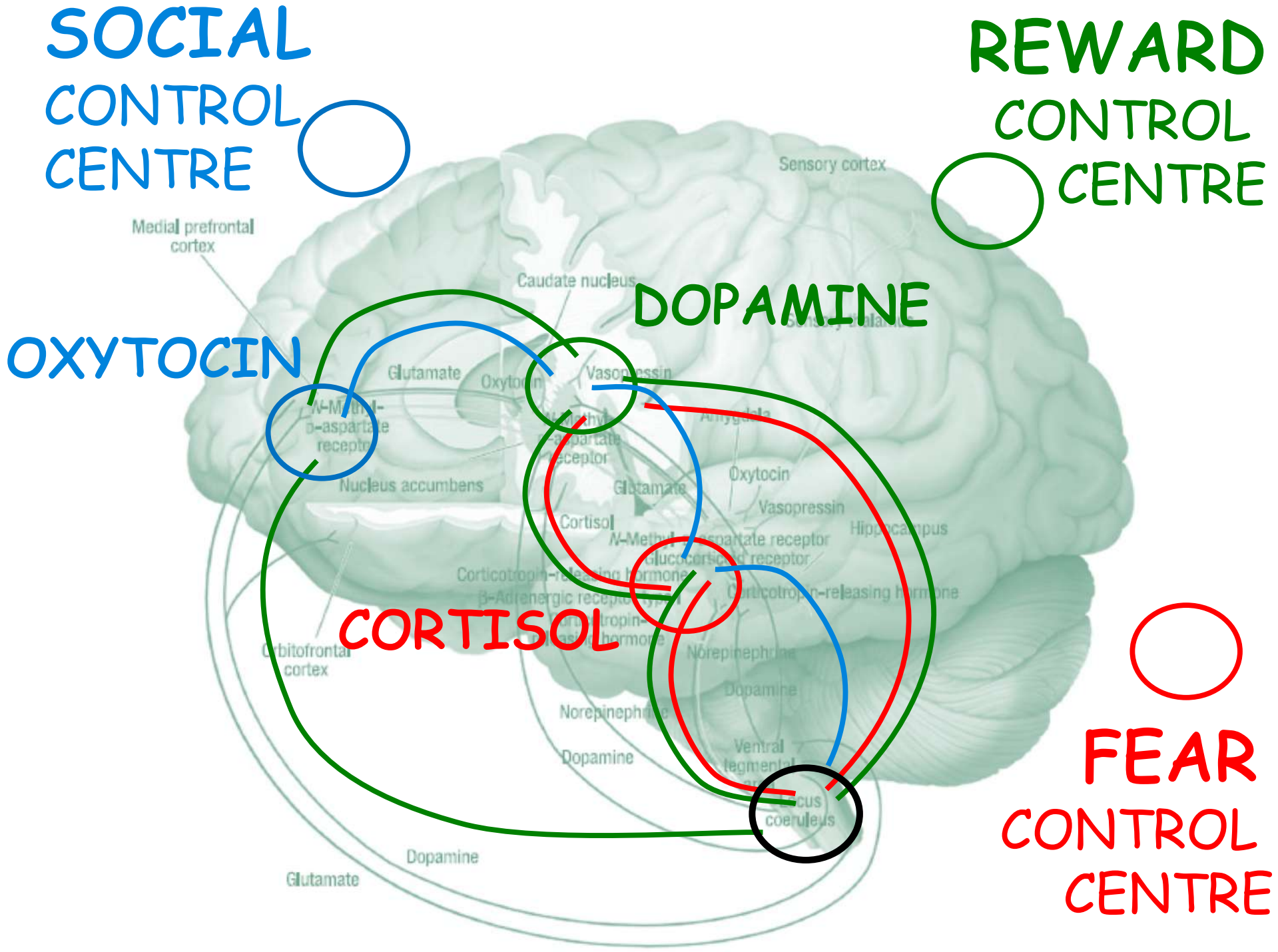


CORTISOL

SOCIAL CONTROL CENTRE

REWARD CONTROL CENTRE




SOCIAL
CONTROL
CENTRE
REWARD
CONTROL
CENTRE
OXYTOCIN
DOPAMINE
CORTISOL
FEAR
CONTROL
CENTRE
Medial prefrontal cortex
Caudate nucleus
Sensory cortex
Glutamate
Oxytocin
Vasopressin
Nucleus accumbens
Cortisol
Hippocampus
Norepinephrine
Dopamine
Ventral tegmental
Orbitofrontal cortex
Glutamate
Dopamine

SOCIAL CONTROL CENTRE

REWARD CONTROL CENTRE

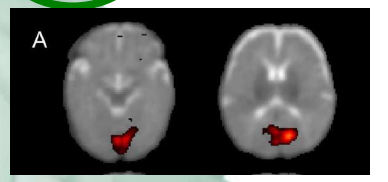
DOPAMINE

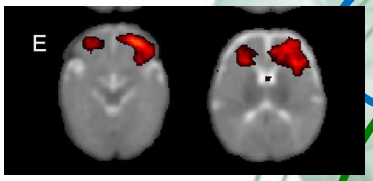
OXYTOCIN

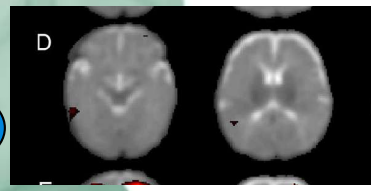
CORTISOL

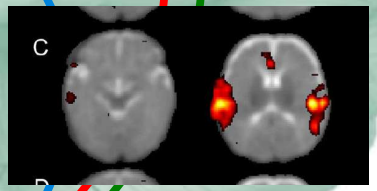
EMOTION CONTROL CENTRE

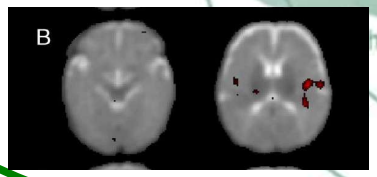
FEAR CONTROL CENTRE



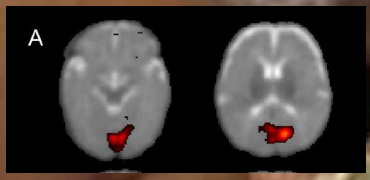


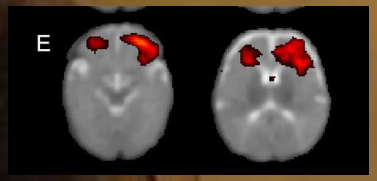


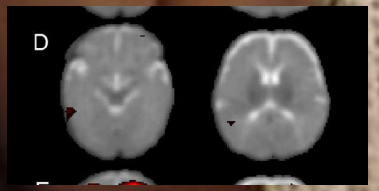


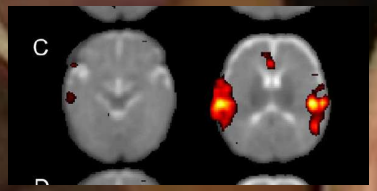


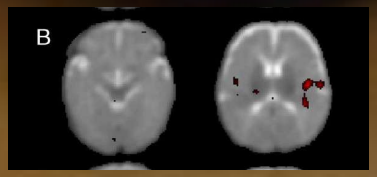
HIGHLY CONSERVED NEURO-ENDOCRINE BEHAVIOR











EMOTION
CONTROL
CENTRE

SOCIAL CONTROL CENTRE

REWARD CONTROL CENTRE

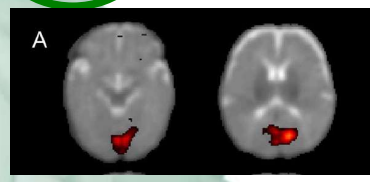
DOPAMINE

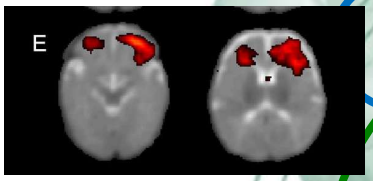
OXYTOCIN

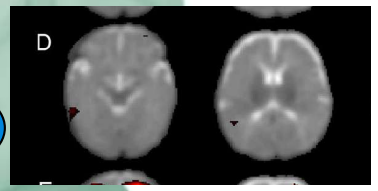
CORTISOL

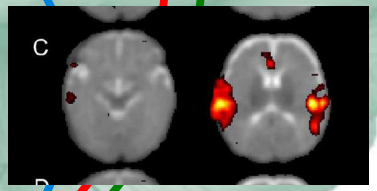
EMOTION CONTROL CENTRE

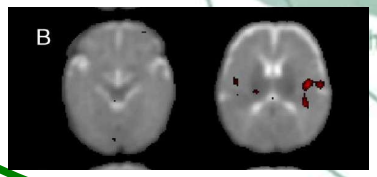
FEAR CONTROL CENTRE

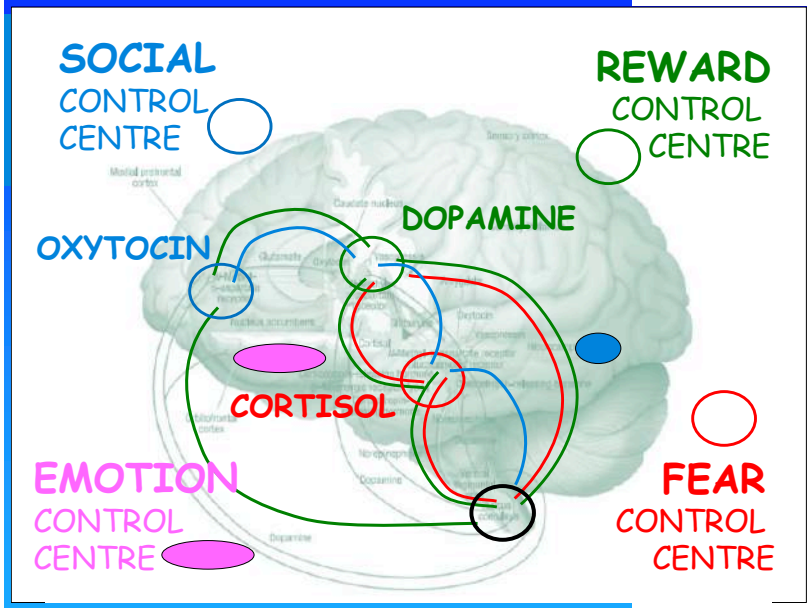










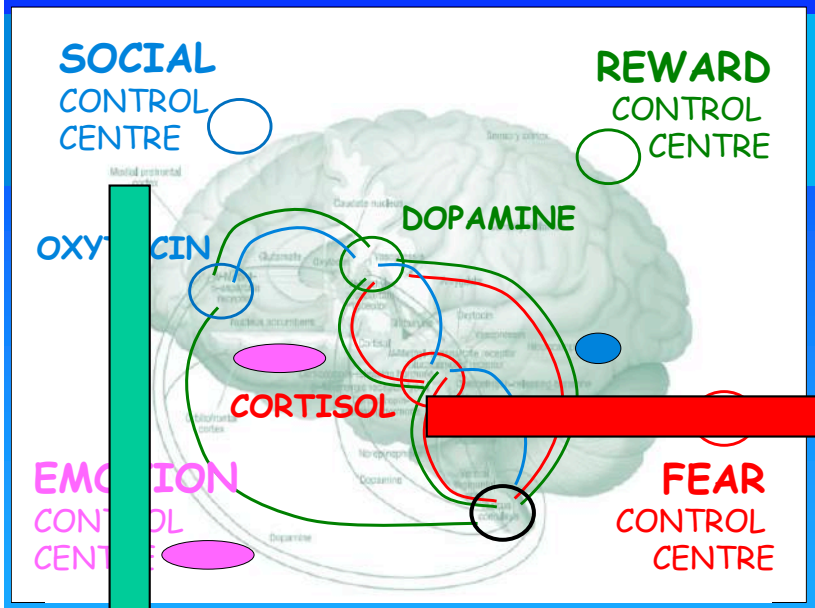


Dennis S. Charney, M.D.

Psychobiological Mechanisms of Resilience and Vulnerability:

Implications for Successful Adaptation to Extreme Stress

… there is considerable overlap in the brain structures associated with these neural mechanisms … functional interactions among the circuits.



An overly responsive FEAR circuit … may negatively influence functioning of the reward system.

… a properly functioning REWARD circuit may be necessary for positive social behaviors.

REWARD

Resilience

FEAR

Vulnerability

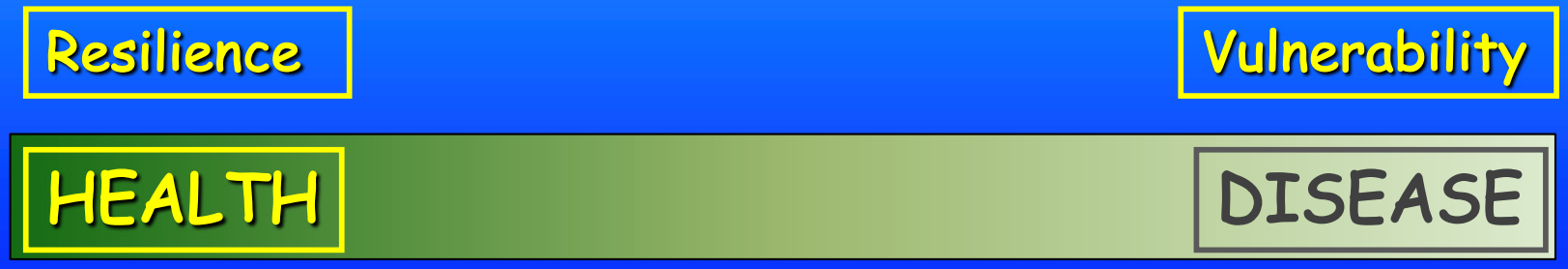
HEALTH

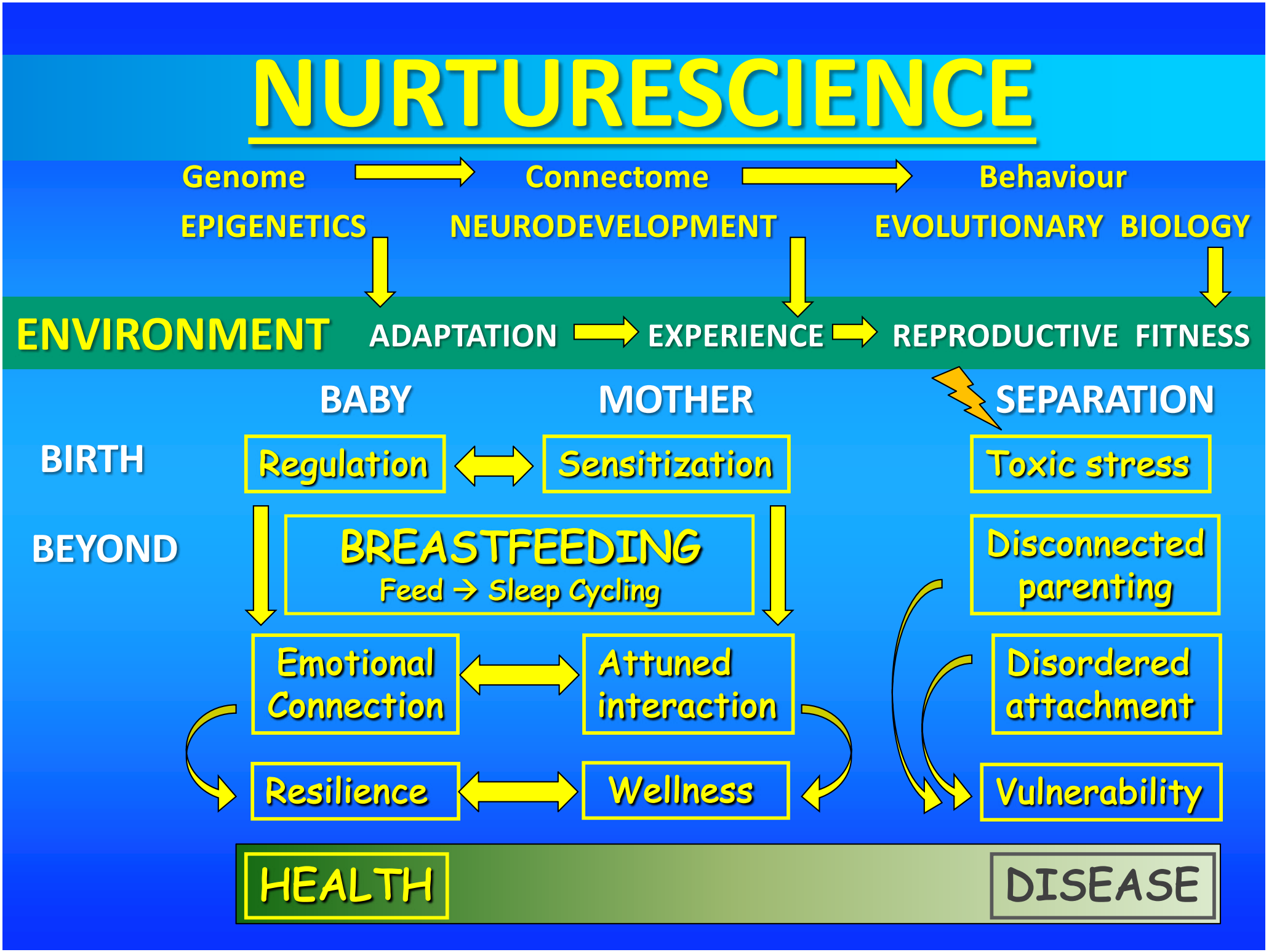
DISEASE

RESILIENCE

(= STRESS RESISTANCE)

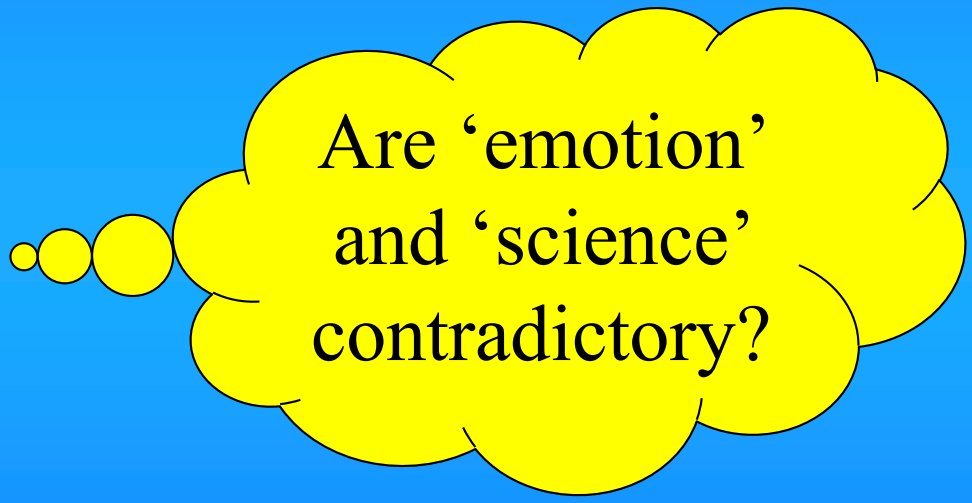
"capacity to maintain healthy emotional functioning in the after-math of stressful experiences"




NURTURESCIENCE
Genome
Connectome
Behaviour
EPIGENETICS
NEURODEVELOPMENT
EVOLUTIONARY BIOLOGY
ENVIRONMENT
ADAPTATION
EXPERIENCE
REPRODUCTIVE FITNESS
BABY
MOTHER
SEPARATION
BIRTH
Regulation
Sensitization
Toxic stress
BEYOND
BREASTFEEDING
Feed → Sleep Cycling
Disconnected parenting
Emotional Connection
Attuned interaction
Disordered attachment
Resilience
Wellness
Vulnerability
HEALTH
DISEASE

INTRODUCING NURTURESCIENCE

Jaak Panksepp dedicated his professional career to the study of mammalian emotions



(TED talk) https://www.youtube.com/watch?v=65e2qScV_K8

INTRODUCING NURTURESCIENCE

Jaak Panksepp dedicated his professional career to the study of mammalian emotions

(TED talk)

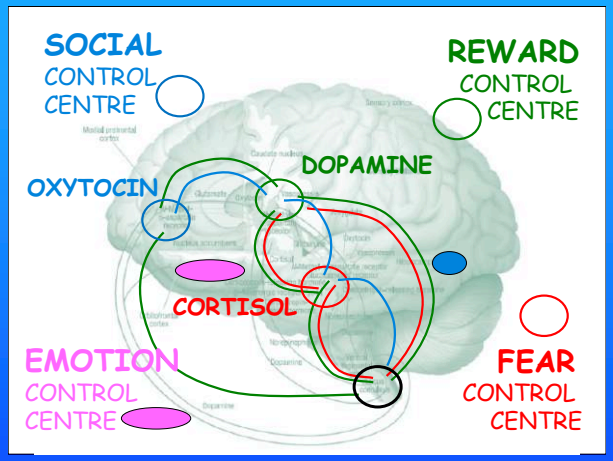
Introducing NURTURESCIENCE a new model with ancient roots.

Instituto Europeo de
Salud Mental Perinatal

… with focus on long term mental health benefits.

Introducing NURTURESCIENCE a new model with ancient roots.

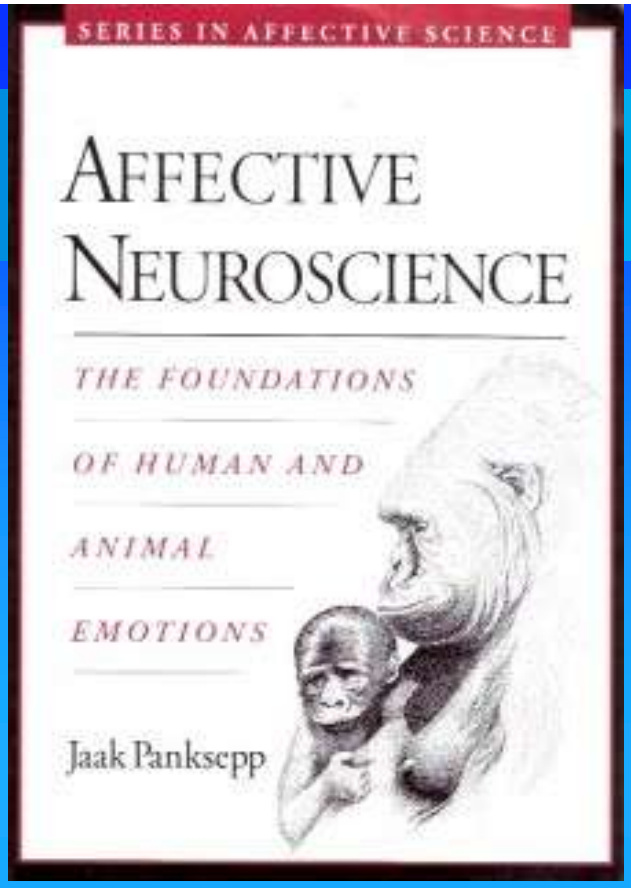
Instituto Europeo de
Salud Mental Perinatal

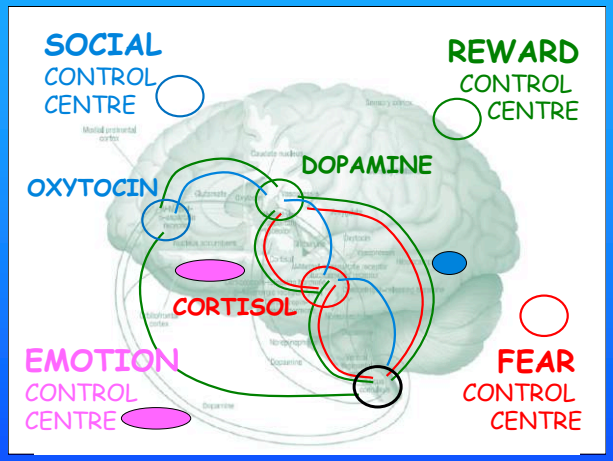


... with focus on long term mental health benefits.

HEALTH

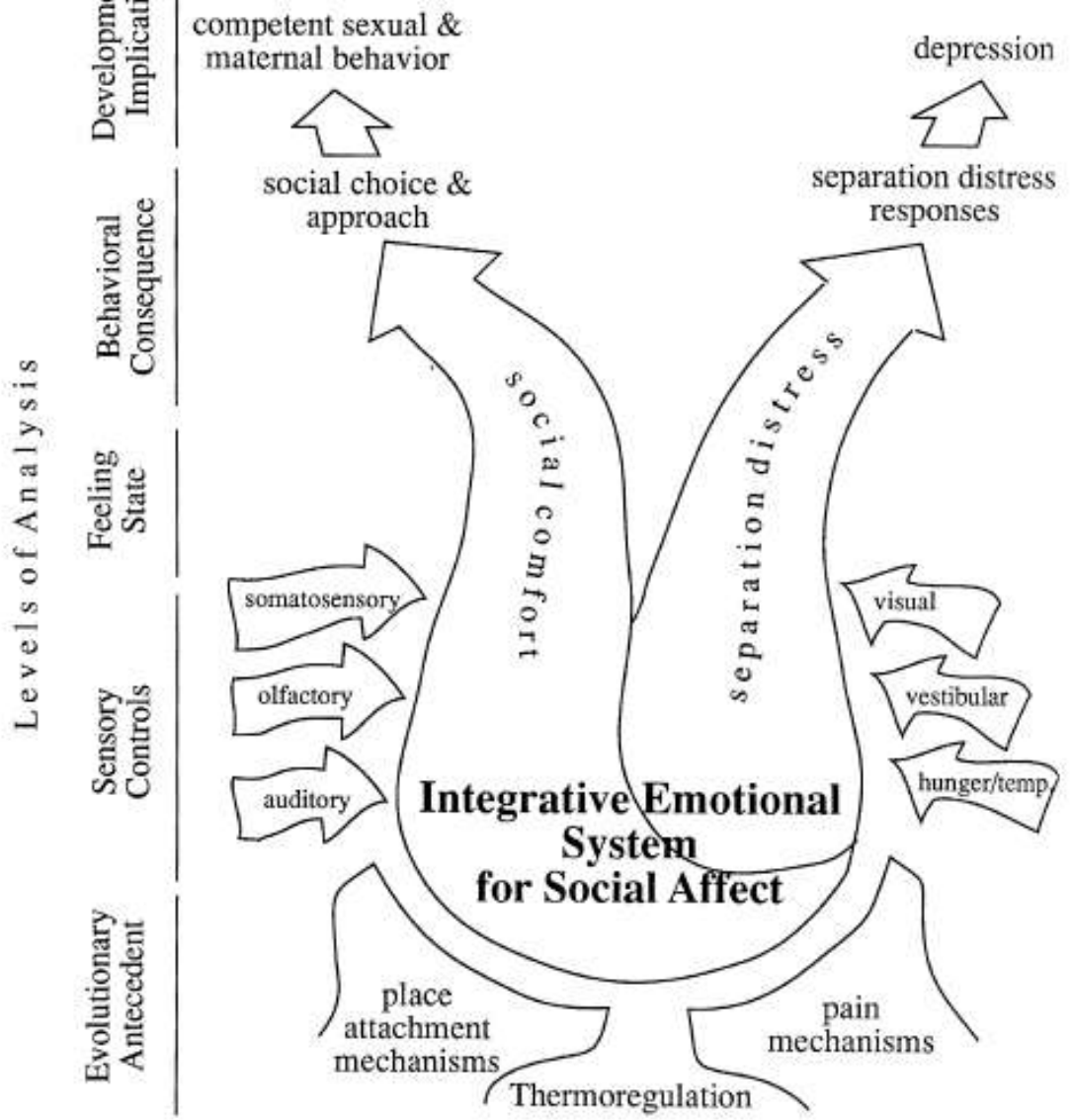
DISEASE





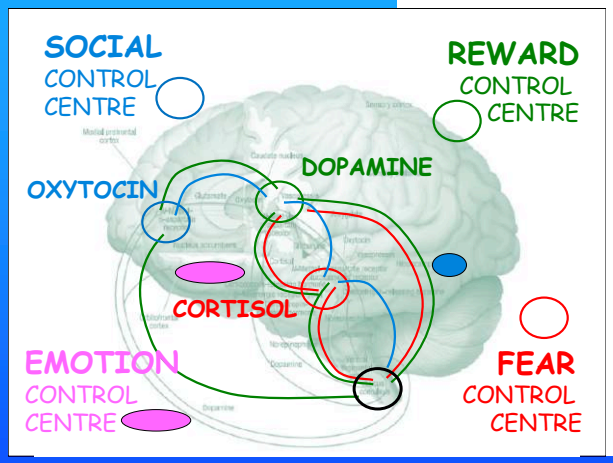
HEALTH

DISEASE



HEALTH

DISEASE



somatosensory

olfactory

auditory

visual

vestibular

hunger/temp

Integrative Emotional System for Social Affect

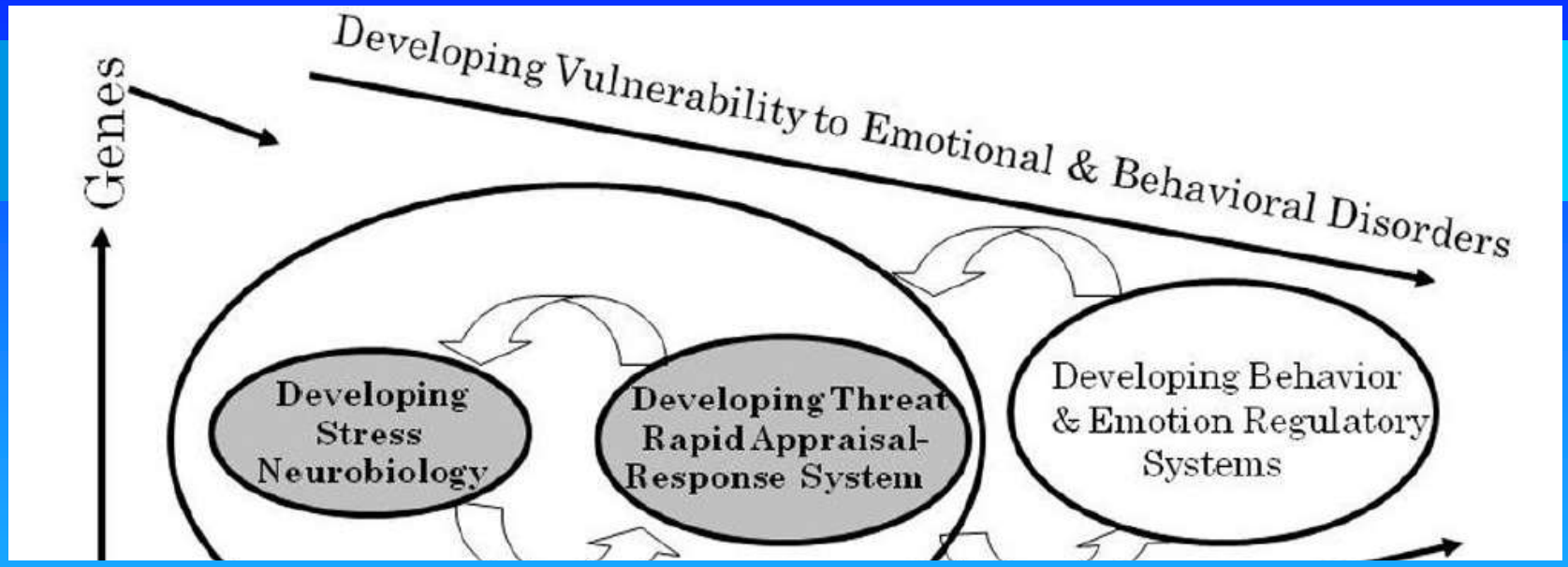
place attachment mechanisms

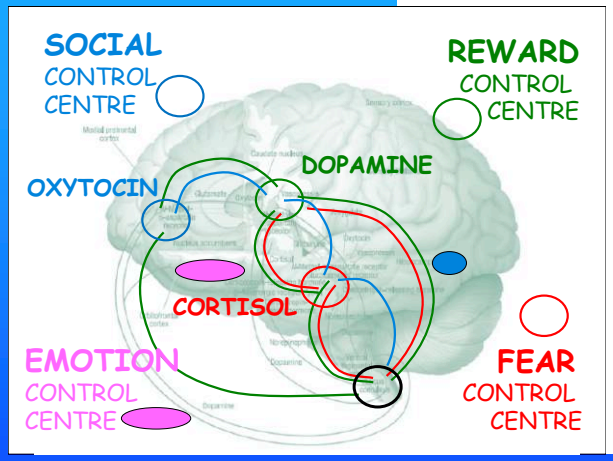
Thermoregulation

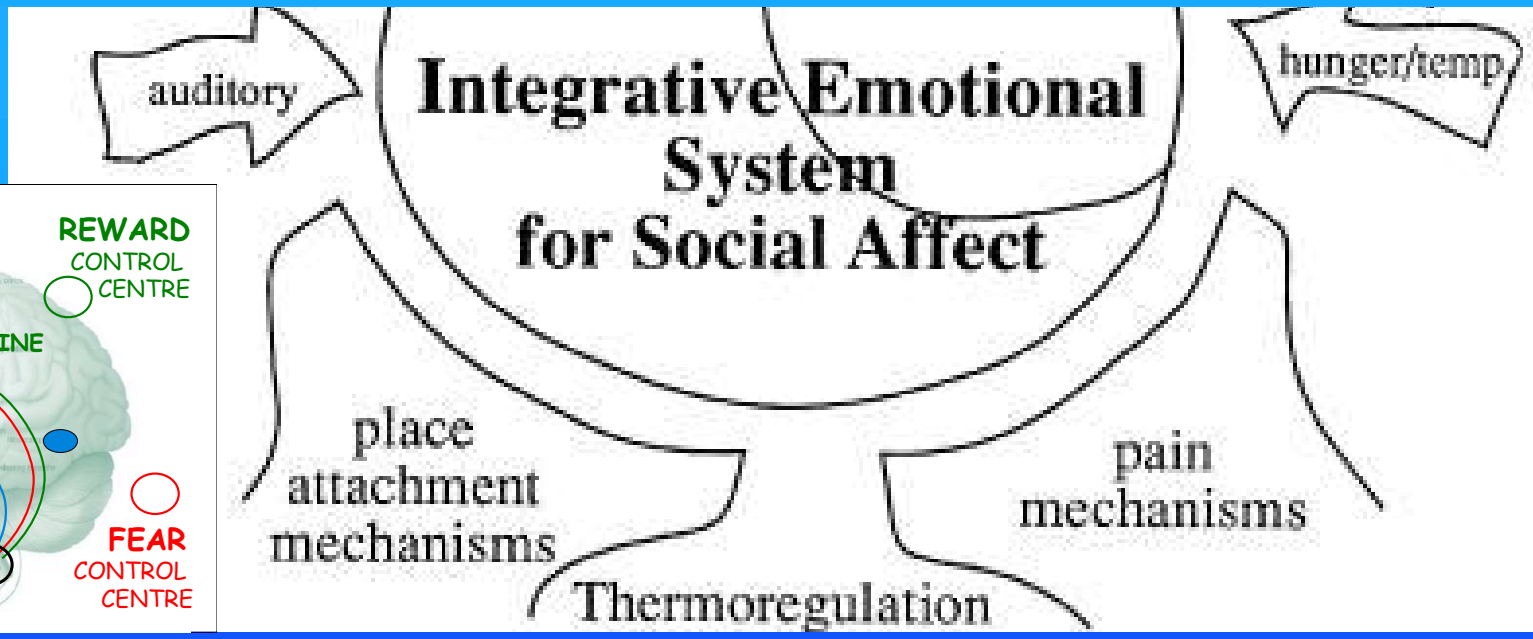
pain mechanisms

HEALTH

DISEASE





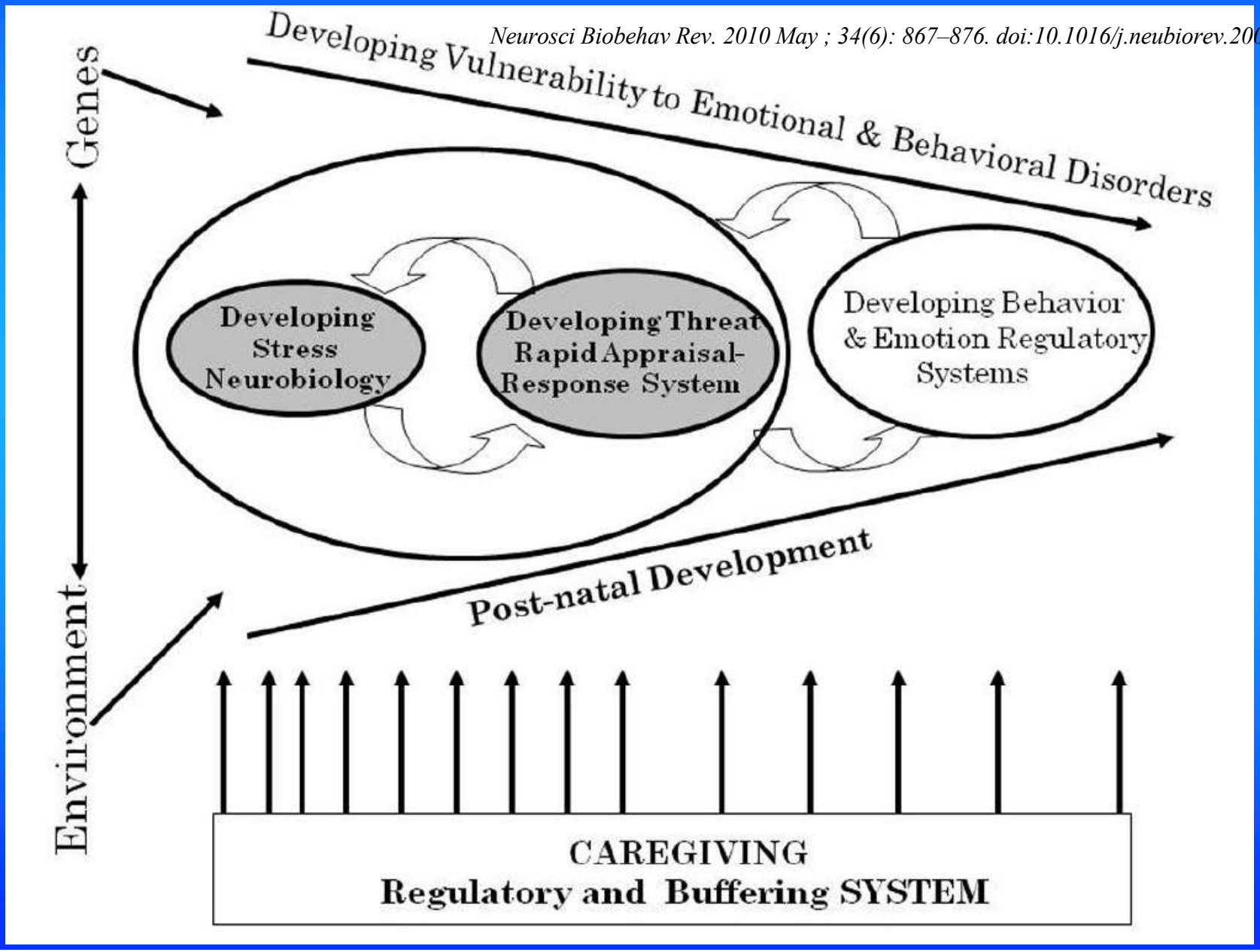


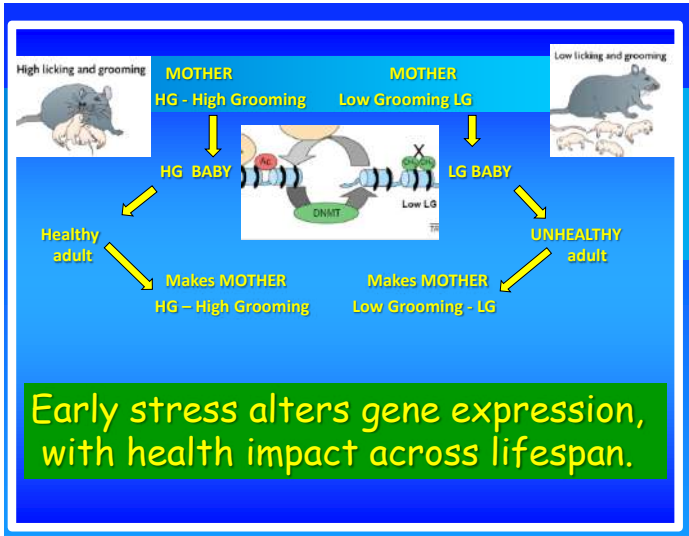
HEALTH

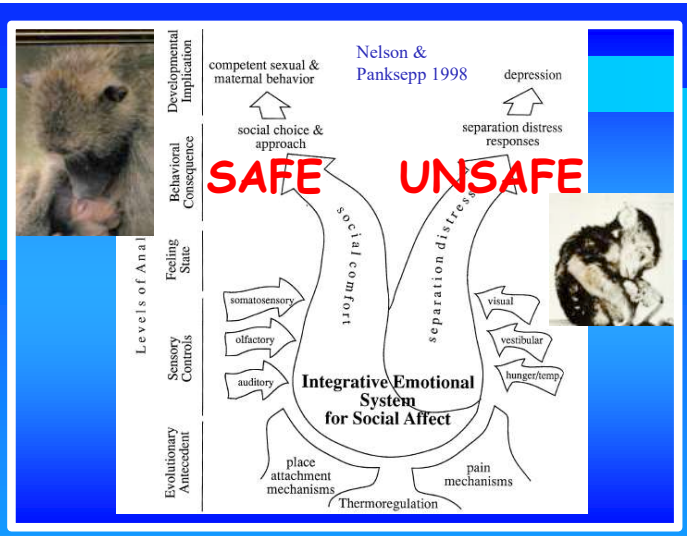
DISEASE

Early Experience and the Development of Stress Reactivity and Regulation in Children (Gunnar 2010)

Neurosci Biobehav Rev. 2010 May ; 34(6): 867–876. doi:10.1016/j.neubiorev.2009.05.007.



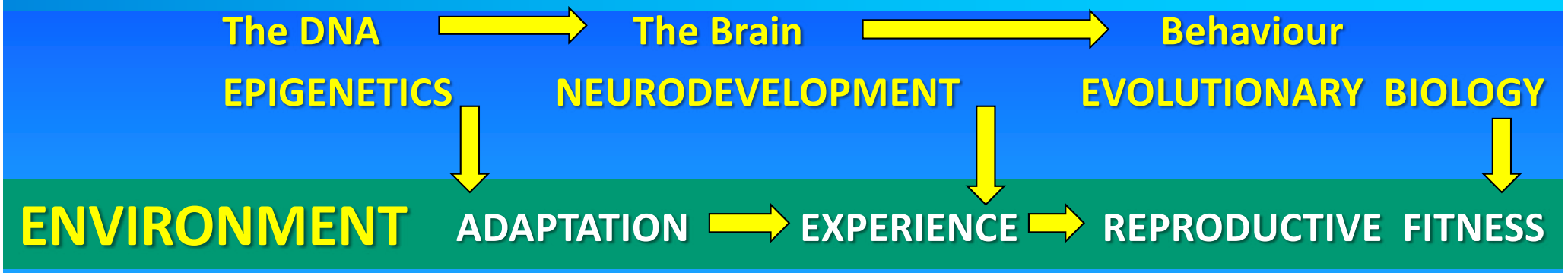


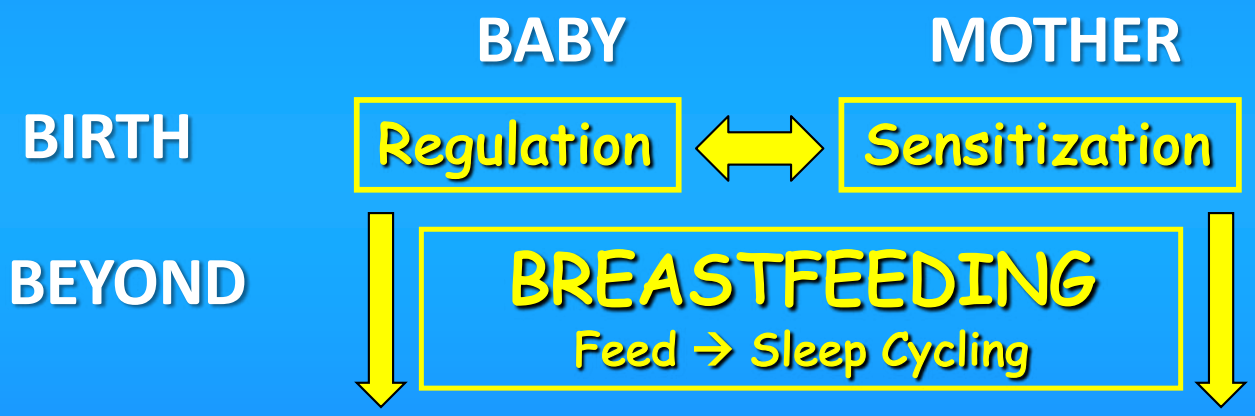


NURTURESCIENCE

CAREGIVING
Regulatory and Buffering SYSTEM

NURTURESCIENCE

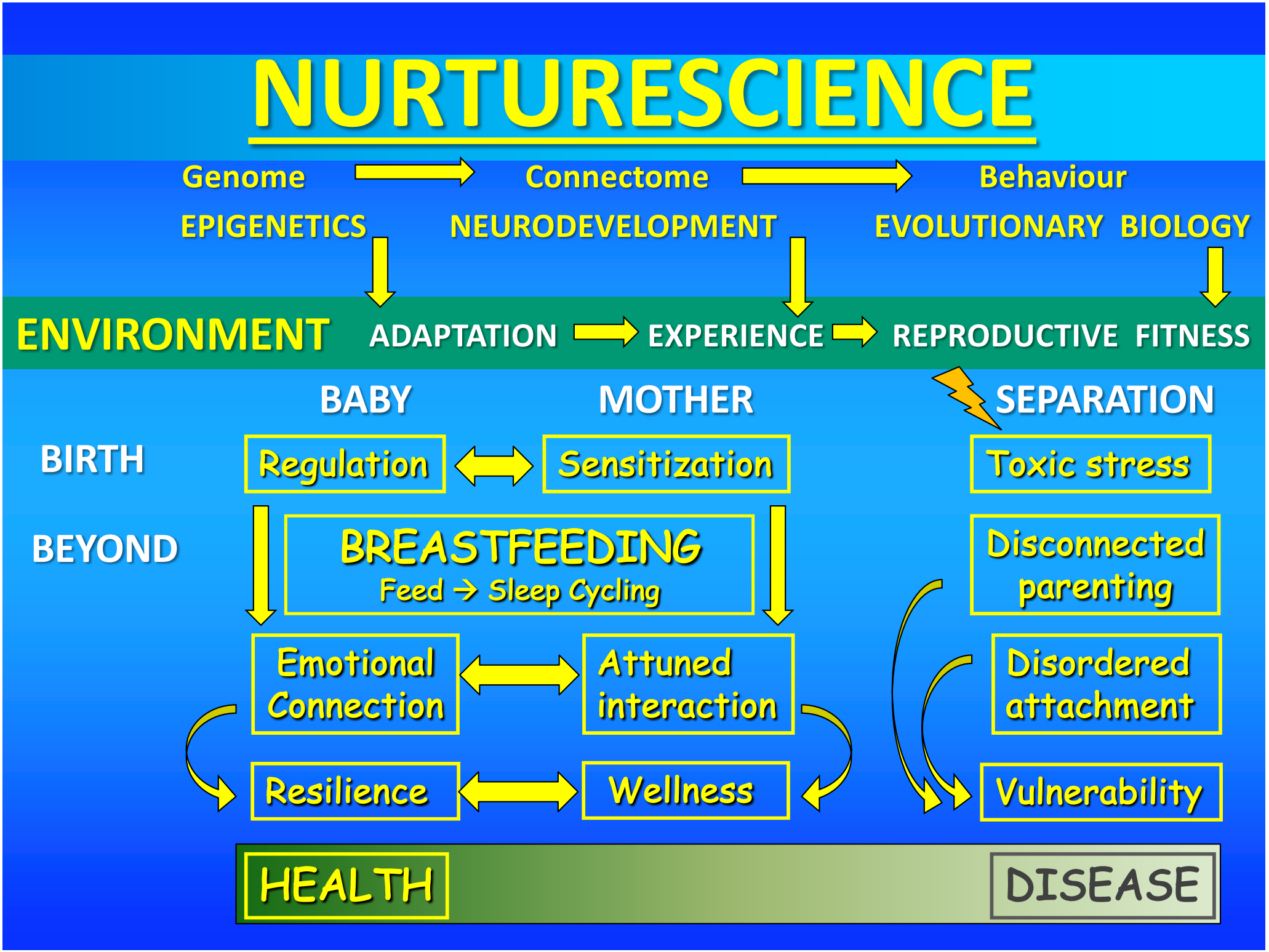




NURTURESCIENCE

CAREGIVING

Regulatory and Buffering SYSTEM


NURTURESCIENCE
Genome
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EPIGENETICS
NEURODEVELOPMENT
EVOLUTIONARY BIOLOGY
ENVIRONMENT
ADAPTATION
EXPERIENCE
REPRODUCTIVE FITNESS
BABY
MOTHER
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Regulation
Sensitization
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BEYOND
BREASTFEEDING
Feed → Sleep Cycling
Disconnected parenting
Emotional Connection
Attuned interaction
Disordered attachment
Resilience
Wellness
Vulnerability
HEALTH
DISEASE

NURTURESCIENCE

The DNA → The Brain → Behaviour

EPIGENETICS NEURODEVELOPMENT EVOLUTIONARY BIOLOGY

ENVIRONMENT → ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

BABY MOTHER SEPARATION

Toxic stress

Intrusive parenting

Disordered attachment

Vulnerability

February 19, 2018

Cognitive Outcomes of Children Born Extremely or Very Preterm Since the 1990s and Associated Risk Factors

A Meta-analysis and Meta-regression

E. Sabrina Twilhaar, MSc[1]; Rebecca M. Wade, MSc[1]; Jorrit F. de Kieviet, MD, PhD[1]; et al

HEALTH DISEASE

JAMA Pediatr. 2018 Feb 19. doi: 10.1001/jamapediatrics.2017.5323. [Epub ahead of print]

Cognitive Outcomes of Children Born Extremely or Very Preterm Since the 1990s and Associated Risk Factors: A Meta-analysis and Meta-regression.

Twilhaar ES[1], Wade RM[1], de Kieviet JF[1], van Goudoever JB[2,3], van Elburg RM[2,4], Oosterlaan J[1,2,3].

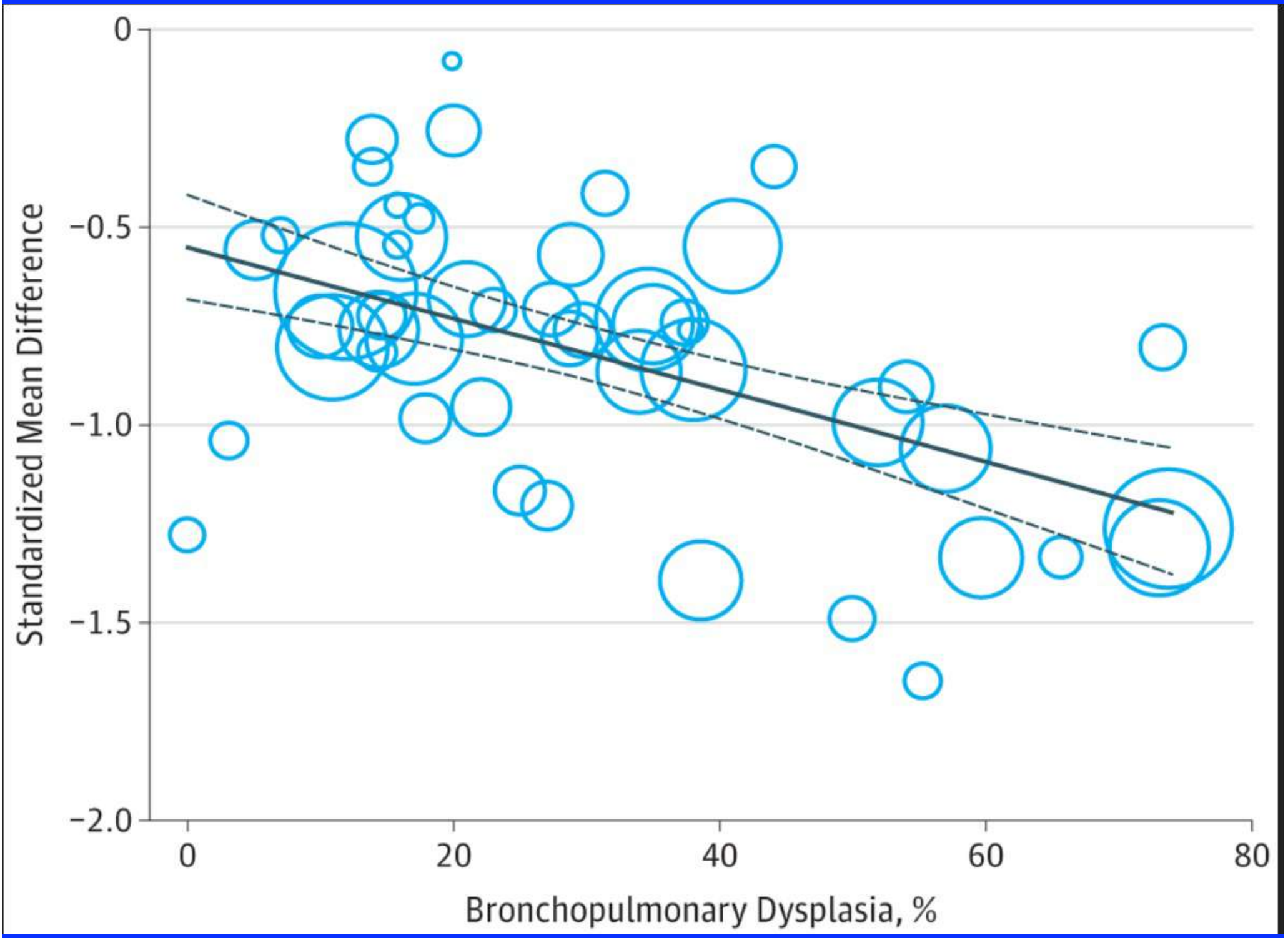
Feb 19, 2018

Conclusions and Relevance:

Extremely or very preterm children born in the antenatal corticosteroids and surfactant era show large deficits in intelligence. No improvement in cognitive outcome was observed between 1990 and 2008.

…

Bronchopulmonary dysplasia was found to be a crucial factor for cognitive outcome. Lowering the high incidence of BPD may be key to improving long-term outcomes after EP/VP birth.


0
−0.5
−1.0
−1.5
−2.0
Standardized Mean Difference
0
20
40
60
80
Bronchopulmonary Dysplasia, %

The Stockholm Neonatal Family Centered Care Study: Effects on Length of Stay and Infant Morbidity

WHAT'S KNOWN ON THIS SUBJECT: Although advances in technology and medical treatment have allowed more infants to survive, morbidity remains high. The NICU environment and early parent-infant interaction have been associated with infant health and length of hospital stay.

WHAT THIS STUDY ADDS: Data from this study indicate that parents staying in the NICU from admission to discharge may reduce the total length of stay for infants born prematurely. An individual-room NICU design could have a direct effect on infant stability and morbidity.

AUTHORS: Annica Örtenstrand, RN, PhD,[a] Björn Westrup, MD, PhD,[b,c] Eva Berggren Broström MD, PhD,[a] Susanne Åkerström, RN Brune, MD,[c] Lene Lindberg, Psych Waldenström, RN, RM, BA, PhD[e]

[a]Department of Clinical Science and Sachs Children's Hospital, [b]Divisions [e]Reproductive and Perinatal Health and Child Health, and [d]Division of Ap Department of Public Health Science Stockholm, Sweden; and [c]Astrid Lind Danderyd, Karolinska University Hos

n = 366

CONTROL GROUP: parents visit 6 - 10 hours per day

INTERVENTION : parents admitted … present 24 h per day

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[a]Department of Clinical Science and Education, Södersjukhuset, Sachs Children's Hospital, [b]Divisions of Neonatology and [e]Reproductive and Perinatal Health Care, Department of Woman and Child Health, and [d]Division of Applied Public Health, Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden; and [c]Astrid Lindgren Children's Hospital, Danderyd, Karolinska University Hospital, Stockholm, Sweden

BPD[f]		
Non-BPD to mild BPD	180 (98.4)	171 (94.0)
Moderate to severe BPD	3 (1.6)	11 (6.0)
Severe morbidity[g] or death		
No severe morbidity	174 (95.1)	167 (91.3)
Severe morbidity	9 (4.9)	16 (8.7)

The Stockholm Neonatal Family Centered Care Study: Effects on Length of Stay and Infant Morbidity

CONCLUSIONS This study demonstrated a reduction in total length of hospital stay for infants born prematurely by providing facilities for parents to stay in the NICU 24 hours/day from admission to discharge. Analyses of secondary outcomes also suggested a reduction in pulmonary morbidity, such as moderate-to-severe BPD.

INTERVENTION : parents admitted … present 24 h

→ BUFFERING PROTECTION OF ADULT SUPPORT

→ ZERO SEPARATION REDUCES TOXIC STRESS

HEALTH DISEASE

NURTURESCIENCE

Genome → Connectome → Behaviour

EPIGENETICS NEURODEVELOPMENT EVOLUTIONARY BIOLOGY

ENVIRONMENT → ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

BABY MOTHER SEPARATION

Toxic stress

Disconnected parenting

Disordered attachment

Vulnerability

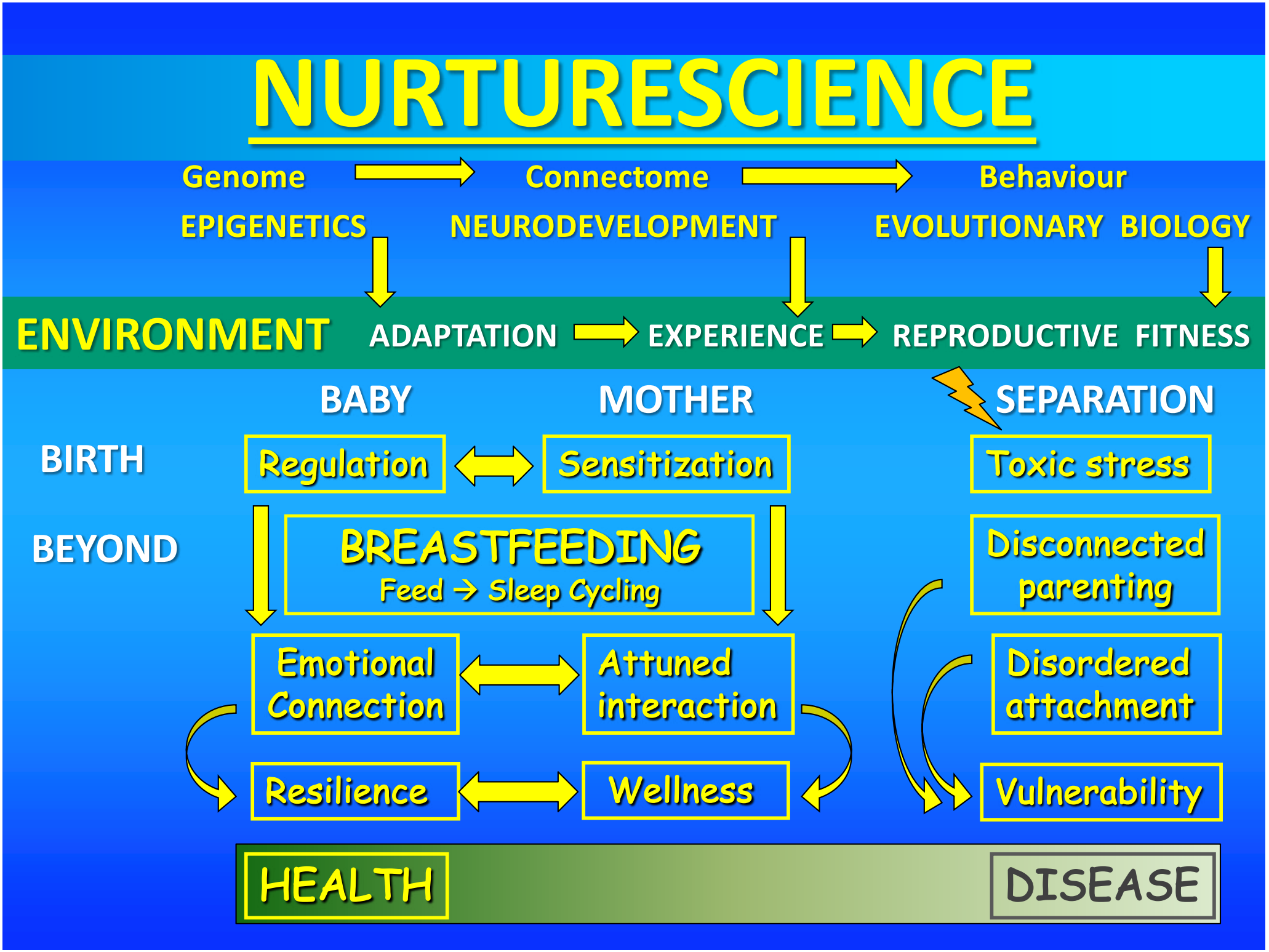
February 19, 2018

Cognitive Outcomes of Children Born Extremely or Very Preterm Since the 1990s and Associated Risk Factors

A Meta-analysis and Meta-regression

E. Sabrina Twilhaar, MSc[1]; Rebecca M. Wade, MSc[1]; Jorrit F. de Kieviet, MD, PhD[1]; et al

HEALTH DISEASE


NURTURESCIENCE
Genome
Connectome
Behaviour
EPIGENETICS
NEURODEVELOPMENT
EVOLUTIONARY BIOLOGY
ENVIRONMENT
ADAPTATION
EXPERIENCE
REPRODUCTIVE FITNESS
BABY
MOTHER
SEPARATION
BIRTH
Regulation
Sensitization
Toxic stress
BEYOND
BREASTFEEDING
Feed → Sleep Cycling
Disconnected parenting
Emotional Connection
Attuned interaction
Disordered attachment
Resilience
Wellness
Vulnerability
HEALTH
DISEASE

NURTURESCIENCE

Neuroscience developed
in the old paradigm of
maternal-infant separation.

a new model with ancient roots.

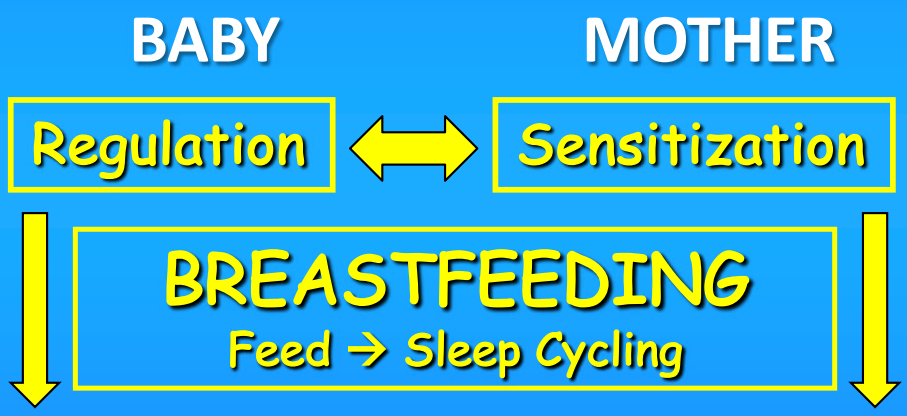
NURTURESCIENCE

Nurturescience now engulfed or embedded in current neuroscience paradigms,

Needs dissecting out →

NURTURESCIENCE

3 primary occupations:



CONNECTING
BREASTFEEDING
SLEEPING

Comparison of nurturescience and neuroscience

	NURTURESCIENCE	NEUROSCIENCE
Key time period	Perinatal, conception to birth to 1 month	1 month – 3 years (ECD)

→ First 1000 days

Early Childhood Development

Comparison of nurturescience and neuroscience

	NURTURESCIENCE	NEUROSCIENCE
Key time period	Perinatal, conception to birth to 1 month	1 month – 3 years (ECD)

Immediate **AT BIRTH**

First 1000 seconds (1st hour) TRANSITION
MICROBIOTA
SENSITISATION

→ First 1000 days Early Childhood Development

Comparison of nurturescience and neuroscience

	NURTURESCIENCE	NEUROSCIENCE
Key time period	Perinatal, conception to birth to 1 month	1 month – 3 years (ECD)

Immediate **AT BIRTH**

First 1000 seconds (1st hour) TRANSITION
First 1000 minutes (1st day) REGULATION
CONNECTION
SUCKLING / BREAST
First 1000 hours (6 weeks) CONSOLIDATION

Comparison of nurturescience and neuroscience

	NURTURESCIENCE	NEUROSCIENCE
Key time period	Perinatal, conception to birth to 1 month	1 month – 3 years (ECD)

Immediate **AT BIRTH**

First 1000 seconds (1st hour) TRANSITION
First 1000 minutes (1st day) CONNECTION
First 1000 hours (6 weeks) CONSOLIDATION
→ First 1000 days Early Childhood Development

Comparison of nurturescience and neuroscience

	NURTURESCIENCE	NEUROSCIENCE
Key time period	Perinatal, conception to birth to 1 month	1 month – 3 years (ECD)
	First 1000 minutes	First 1000 days
ANS purpose	HOMEORHESIS	HOMEOSTASIS

REGULATION vs STIMULATION

Expected vs Unexpected
Ecologic salience vs Potential threat
Resource growth vs threat readiness

OXYTOCIN vs CORTISOL
HOMEORHESIS vs HOMEOSTASIS
MOTHER vs OTHER

Resilience

HEALTH — DISEASE

Comparison of nurturescience and neuroscience

	NURTURESCIENCE	NEUROSCIENCE
Key time period	Perinatal, conception to birth to 1 month	1 month – 3 years (ECD)
Emotions Regulatory mechanism	Viscera / ANS / limbic brain	Limbic brain / neocortex
	Maternal regulation then co-regulation	Self-regulation (within self)
	Ope	self)

REGULATION vs STIMULATION

Expected vs Unexpected
Ecologic salience vs Potential threat
Resource growth vs threat readiness

OXYTOCIN vs CORTISOL
HOMEORHESIS vs HOMEOSTASIS
MOTHER vs OTHER

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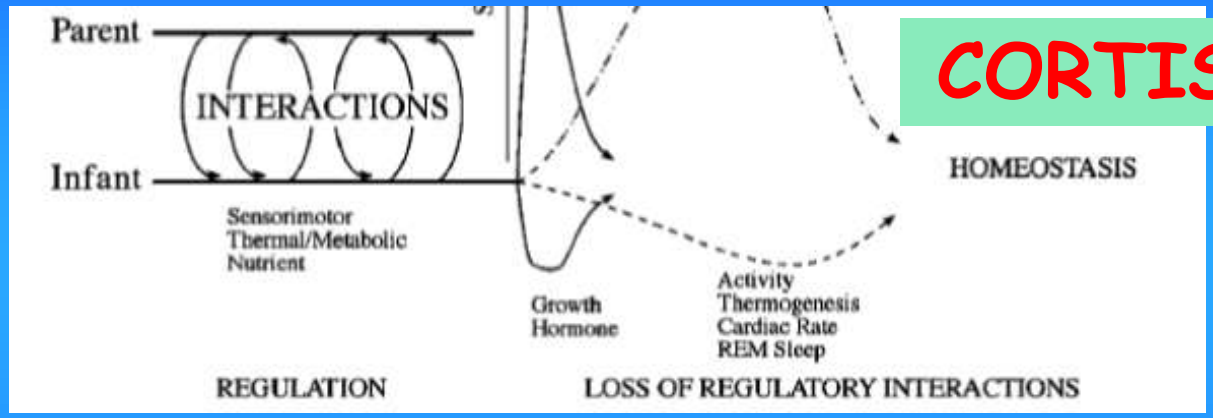
	Open feedback loop (with others)	Closed feed-back loop (within self)



Comparison of nurturescience and neuroscience

	NURTURESCIENCE	NEUROSCIENCE
Key time period	Perinatal, conception to birth to 1 month	1 month – 3 years (ECD)
	First 1000 minutes	First 1000 days
ANS purpose	HOMEORHESIS	HOMEOSTASIS
	Dyadic / family (plural)	Individual (singular)
	Dynamic systems theory	Reductionistic logic

Comparison of nurturescience and neuroscience

	NURTURESCIENCE	NEUROSCIENCE
	Dyadic / family (plural)	Individual (singular)
	Dynamic systems theory	Reductionistic logic

Comparison of nurturescience and neuroscience

	NURTURESCIENCE	NEUROSCIENCE
	Dyadic / family (plural)	Individual (singular)
	Dynamic systems theory	Reductionistic logic

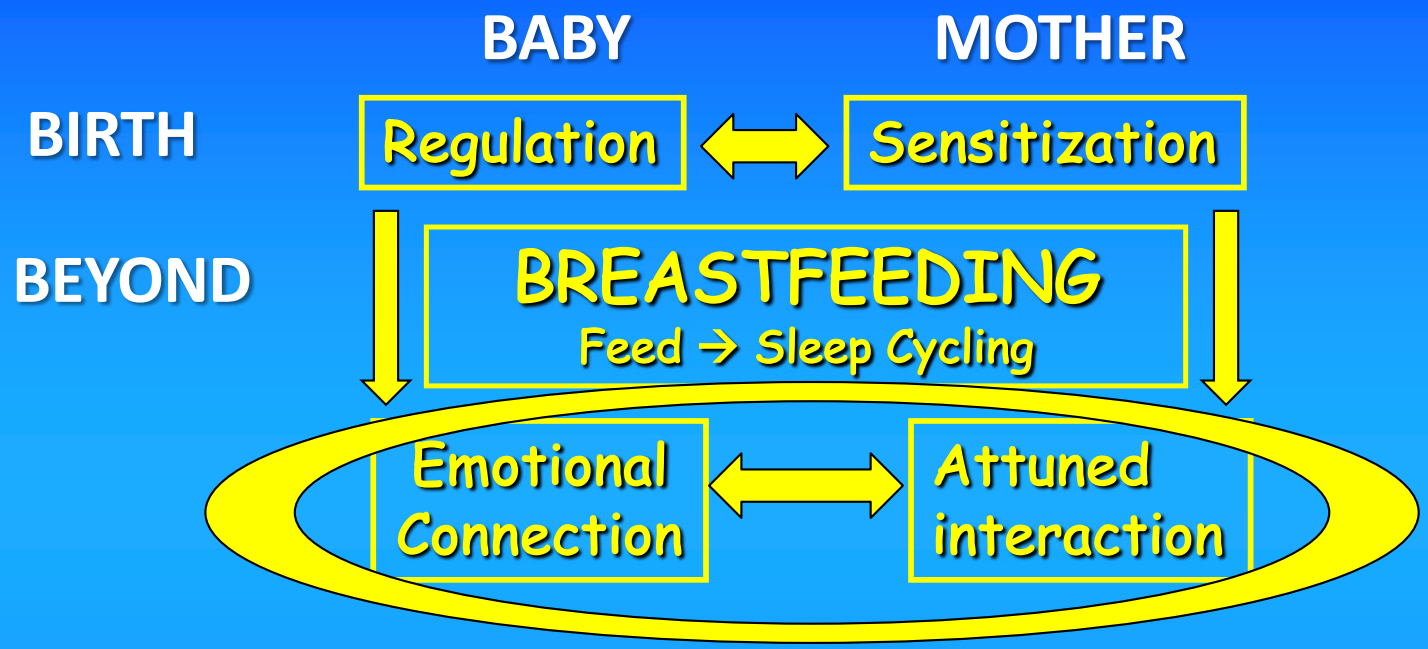
Necessary, but not sufficient

Randomized controlled trials (RCT)
Evidence Based Medicine (EBM)

"Womb ecology becomes world ecology."

Comparison of nurturescience and neuroscience

	NURTURESCIENCE	NEUROSCIENCE
Key time period	Perinatal, conception to birth to 1 month	1 month – 3 years (ECD)
	First 1000 minutes	First 1000 days
ANS purpose	HOMEORHESIS	HOMEOSTASIS
	Dyadic / family (plural)	Individual (singular)
	Dynamic systems theory	Reductionistic logic
KEY OUT-COME	CONNECTION RESILIENCE	ATTACHMENT COGNITION



KEY OUT-COME	CONNECTION RESILIENCE	ATTACHMENT COGNITION

Table 1: Comparison of nurturescience and neuroscience

	*Nurture*science	*Neuro*science
Relevant time period	Perinatal, conception to birth to 1 year First 1000 minutes	1 month – 3 years (ECD) First 1000 days
	Critical periods (brief)	Brain maturation, sensitive periods (long)
Autonomic objective	Homeorhesis	Homeostasis; Allostasis
Emotions regulatory mechanism	Viscera / ANS / Limbic	Limbic brain / neocortex
	Fetus/neonate acutely aware of threat	Infant and toddler develop threat awareness
	Co-regulation, buffering of stress	Self-regulation of stress (within self)
Emotional learning mechanism	ANS primary influence on behavior	CNS primary influence on behavior
	Autonomic learning or conditioning	CNS conditioning, operant
	Fetal & neonatal connectome	Prolonged infant brain maturation
	Maternal peripartum neuroplasticity	Maternal learning of competence
	Open feedback loop (with others)	Closed feed-back loop (within self)
	Dyadic / family (plural)	Individual (singular)

Theoretical roots	Dynamic systems theory, ecology	Reductionistic logic, isolationist
	Biology, ethology, anthropology	Sociology (Maslow, Dunbar)
	Physiology, polyvagal theory	Psychology,
	Epigenetics	Genetics-Epigenetics
	Epigenetic adaptation / maladaptation	Toxic stress, allostatic load
Intervention target	Boost parasympathetic, calming ANS and emotional behavior	Counter sympathetic, excitability CNS and cognition
KEY OUTCOMES	EMOTIONAL CONNECTION RESILIENCE	ATTACHMENT COGNITION
KEY OBJECTIVES	RELATIONAL HEALTH Sociality Interdependence	SELF-ACTUALIZATION (Maslow) Individualistic Independence

Ref: Bergman et al, 2019

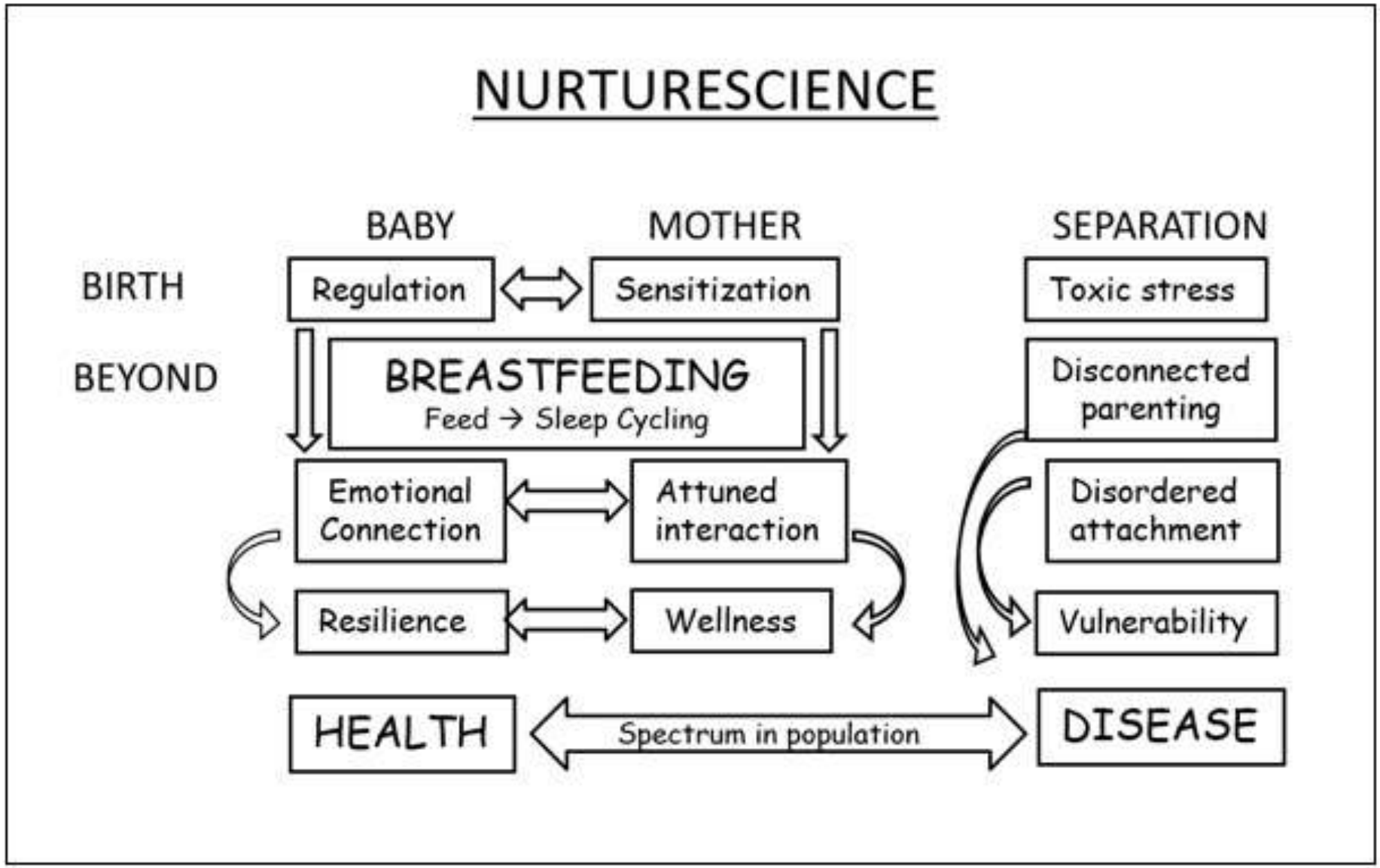
Karolinska Institutet

Nurturescience program now planned for KAROLINSKA, Stockholm

NILS BERGMAN

ULRIKA ADEN

BJORN WESTRUP



Ref: Bergman et al, 2019

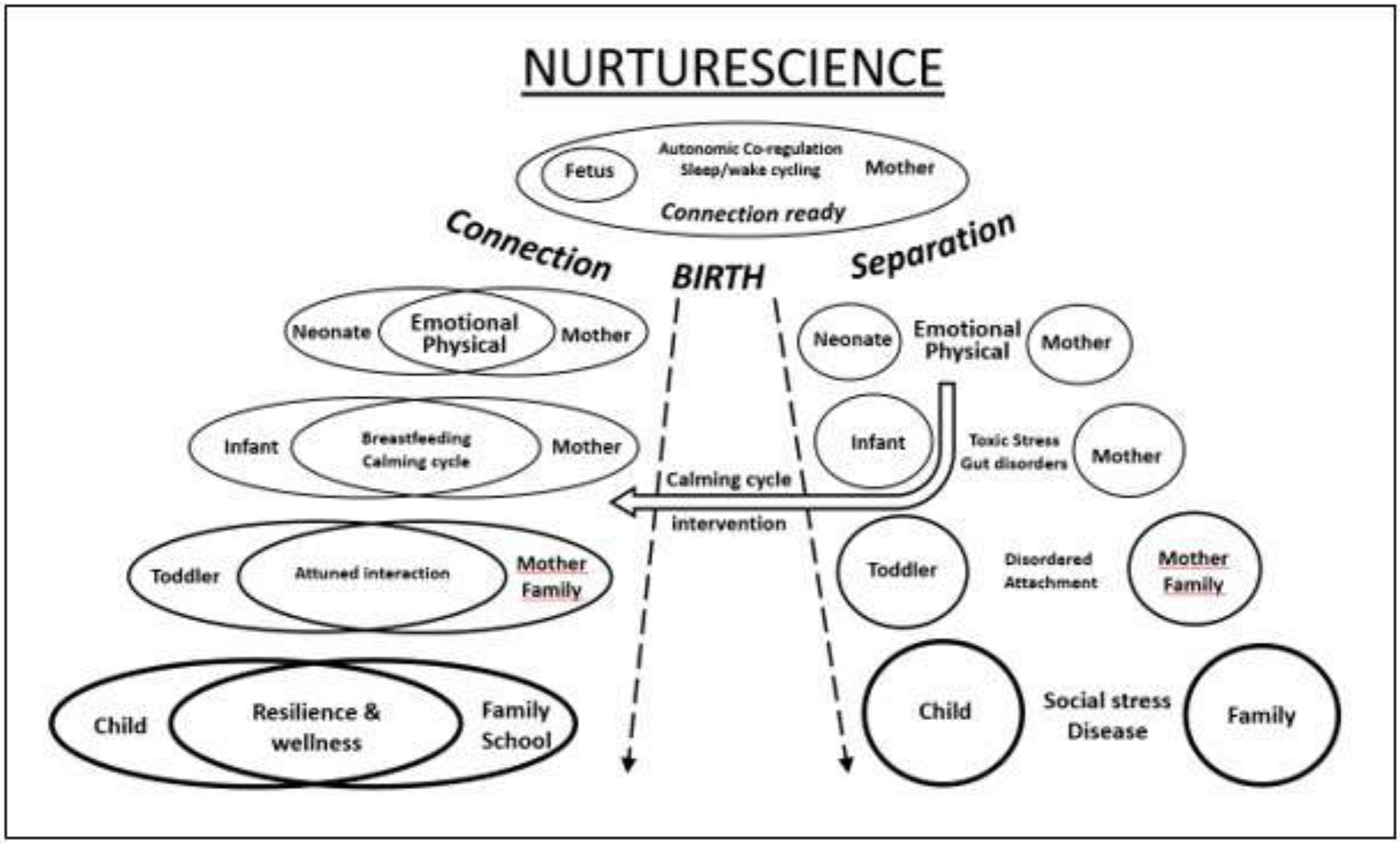
https://nurturescienceprogram.org

CUMC Home Columbia University Departments Giving Maps People

NURTURE SCIENCE PROGRAM
COLUMBIA UNIVERSITY MEDICAL CENTER

MARTHA WELCH

Meyers, Hofer, Fifer, Ludwig etc



Ref: Bergman et al, 2019

DOI: 10.1002/bdr2.1529

Birth Defects Research | The Teratology Society | WILEY

REVIEW ARTICLE

Nurturescience versus neuroscience: A case for rethinking perinatal mother–infant behaviors and relationship

Nils J. Bergman[1] | Robert Ludwig[2] | Björn Westrup[1] | Martha Welch[2,3,4]

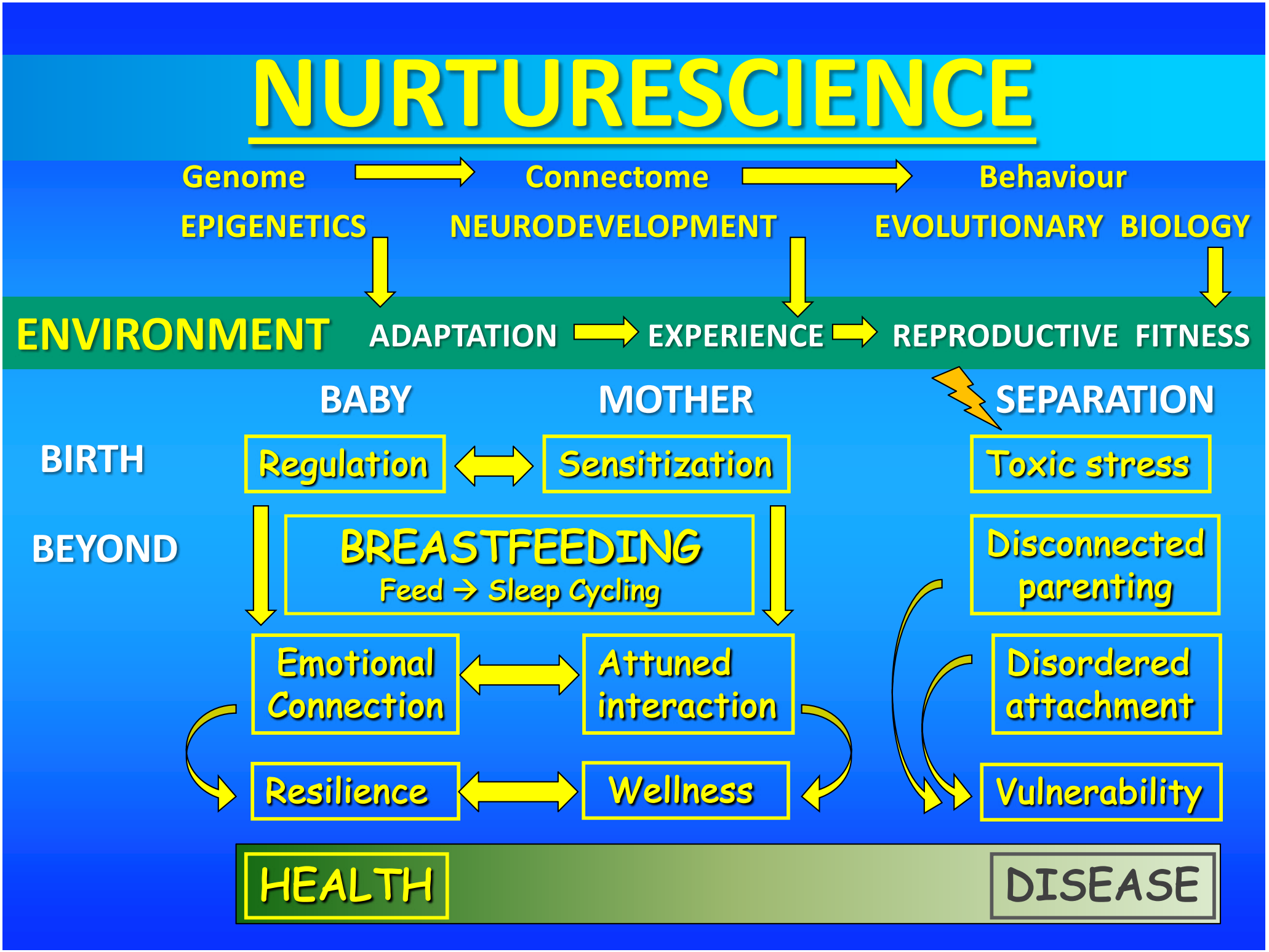
DOI: 10.1002/bdr2.1530

Birth Defects Research | The Teratology Society | WILEY

REVIEW ARTICLE

Birth practices: Maternal-neonate separation as a source of toxic stress

Nils J Bergman


NURTURESCIENCE
Genome
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Resilience
Wellness
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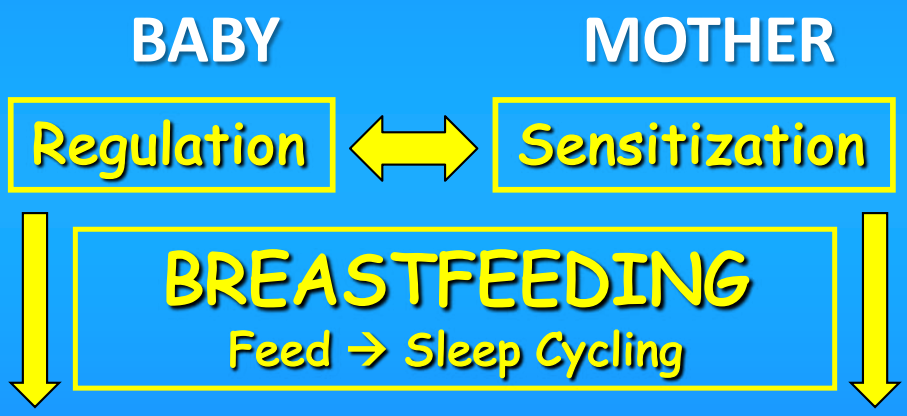
HEALTH
DISEASE

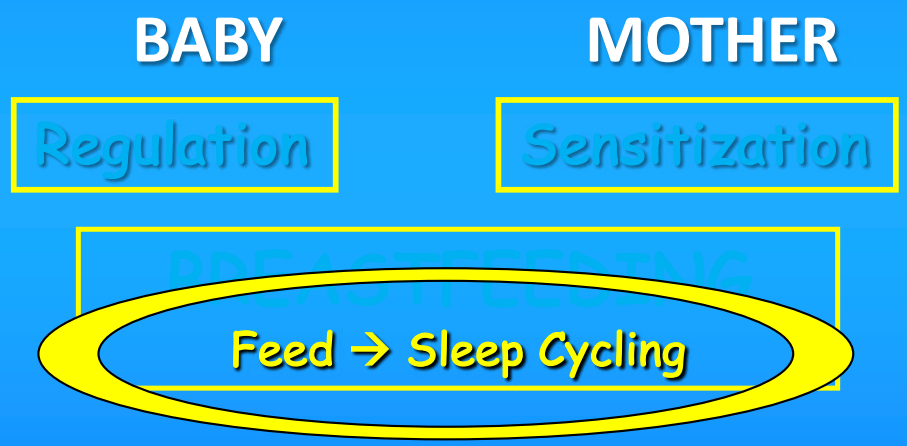
NURTURESCIENCE

3 primary occupations:

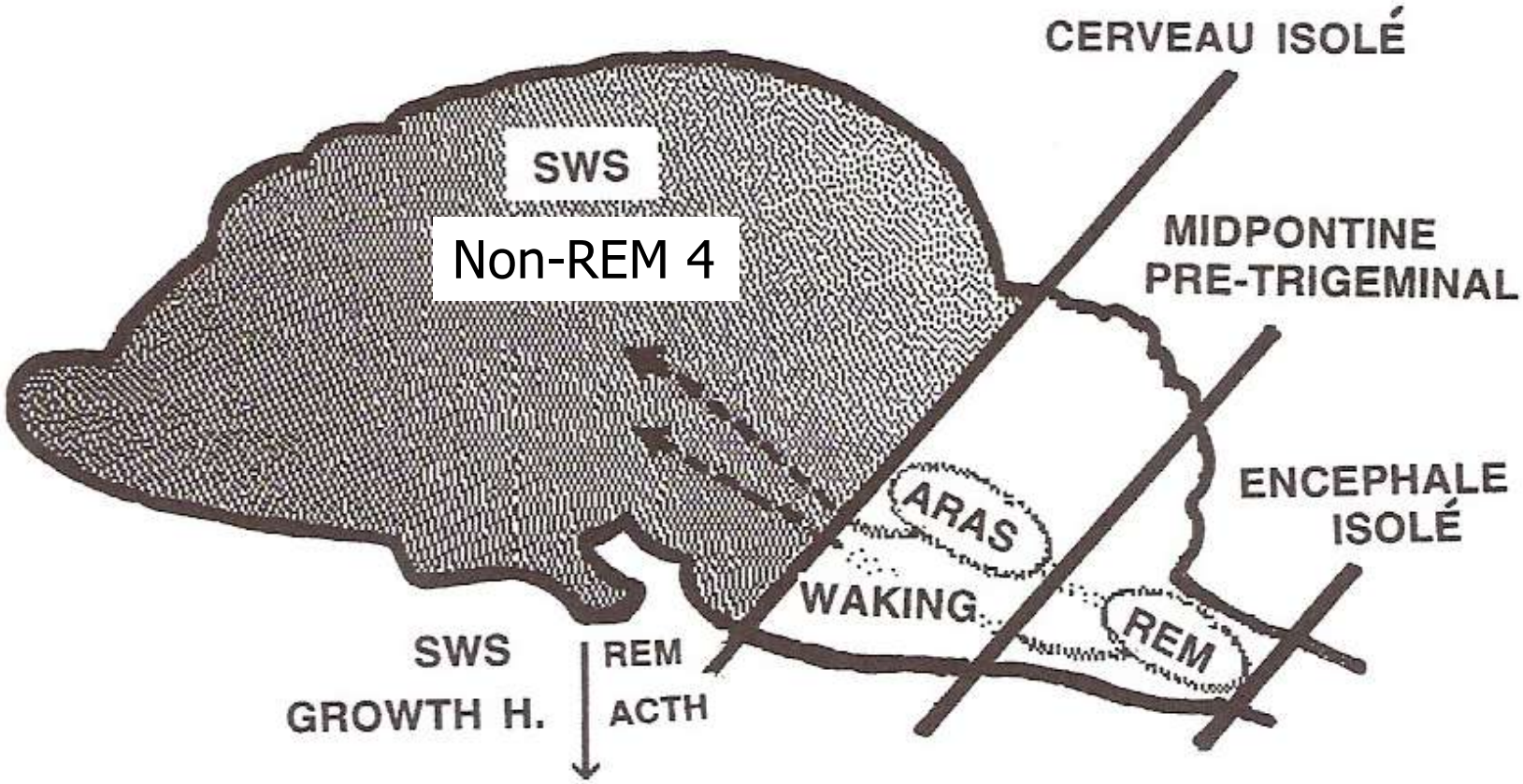


CONNECTING
BREASTFEEDING
SLEEPING

3 primary occupations:

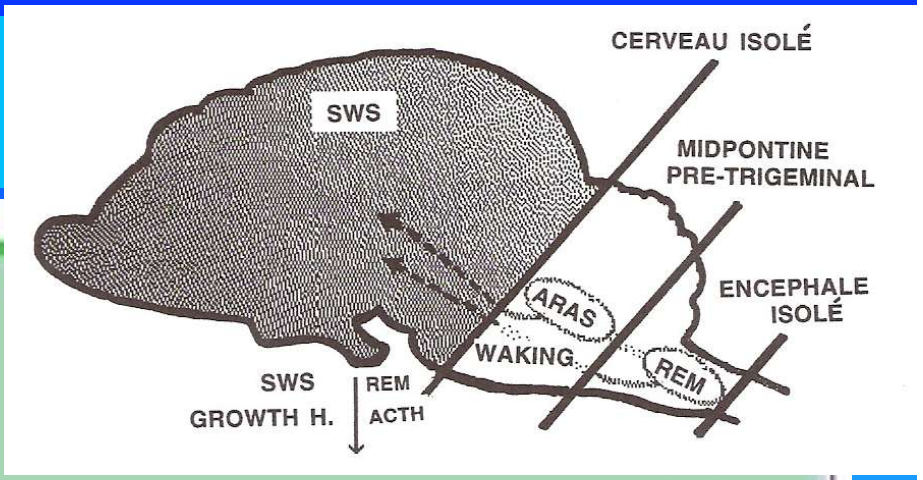


CONNECTING
BREASTFEEDING
SLEEPING

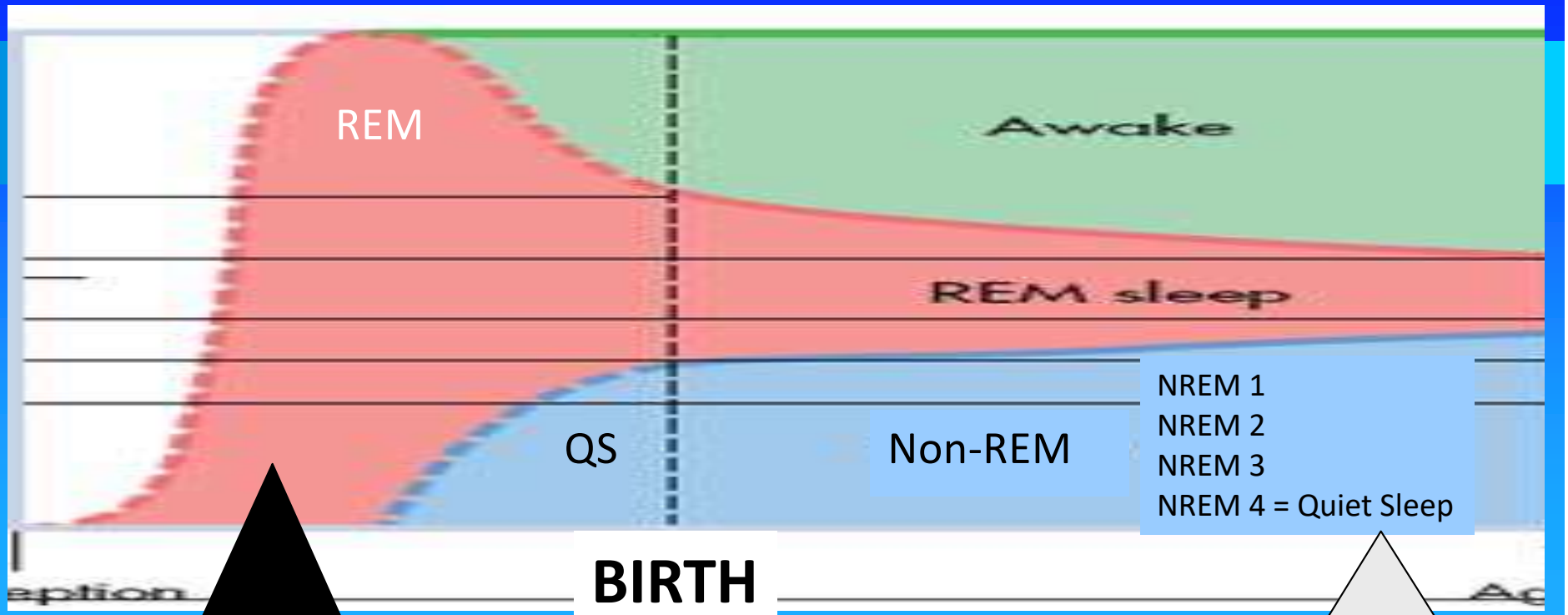


Panksepp 1998
Siegel 2005

Figure 7.2. Overview of the types of brain transections that led to the general locations of major waking, SWS, and REM systems within the neuro- axis. For instance, with the midpontine pretrigeminal cut, waking and SWS were left in the forebrain, while the potential for REM was only manifested in neural and bodily systems below the cut. When the cut was slightly further rostral, through the midbrain (i.e., the *cereveau isolé* cut), the forebrain remained perpetu-ally in the darkness of SWS, while tissue below the cut cycled between waking type arousal and activated sleep states. Also, note that growth hormone secretion from the pituitary occurs in conjunction to SWS episodes, while ACTH secretion is entrained to REM periods.



1st 1000 days



BIRTH

REM

QS

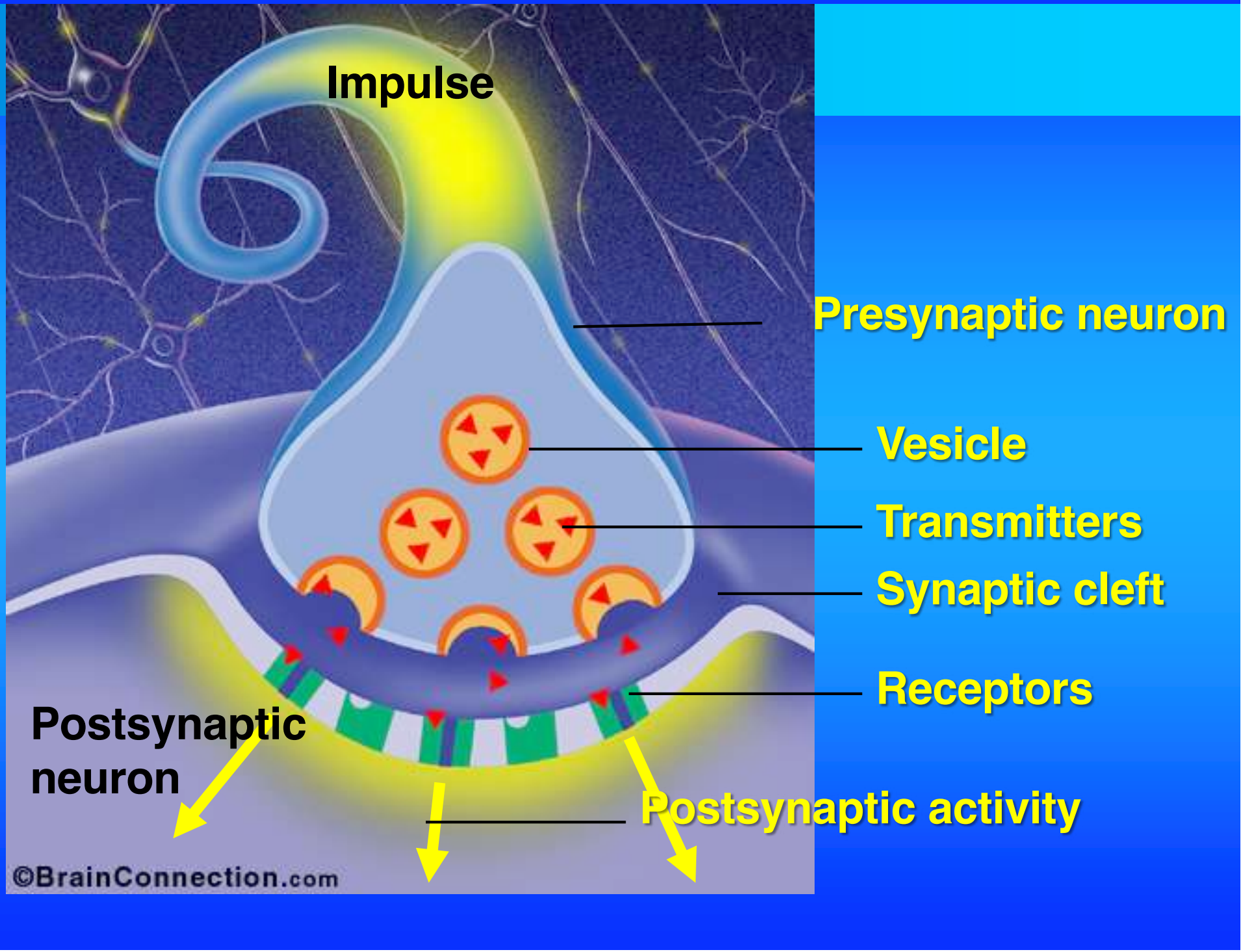
1st 270 days

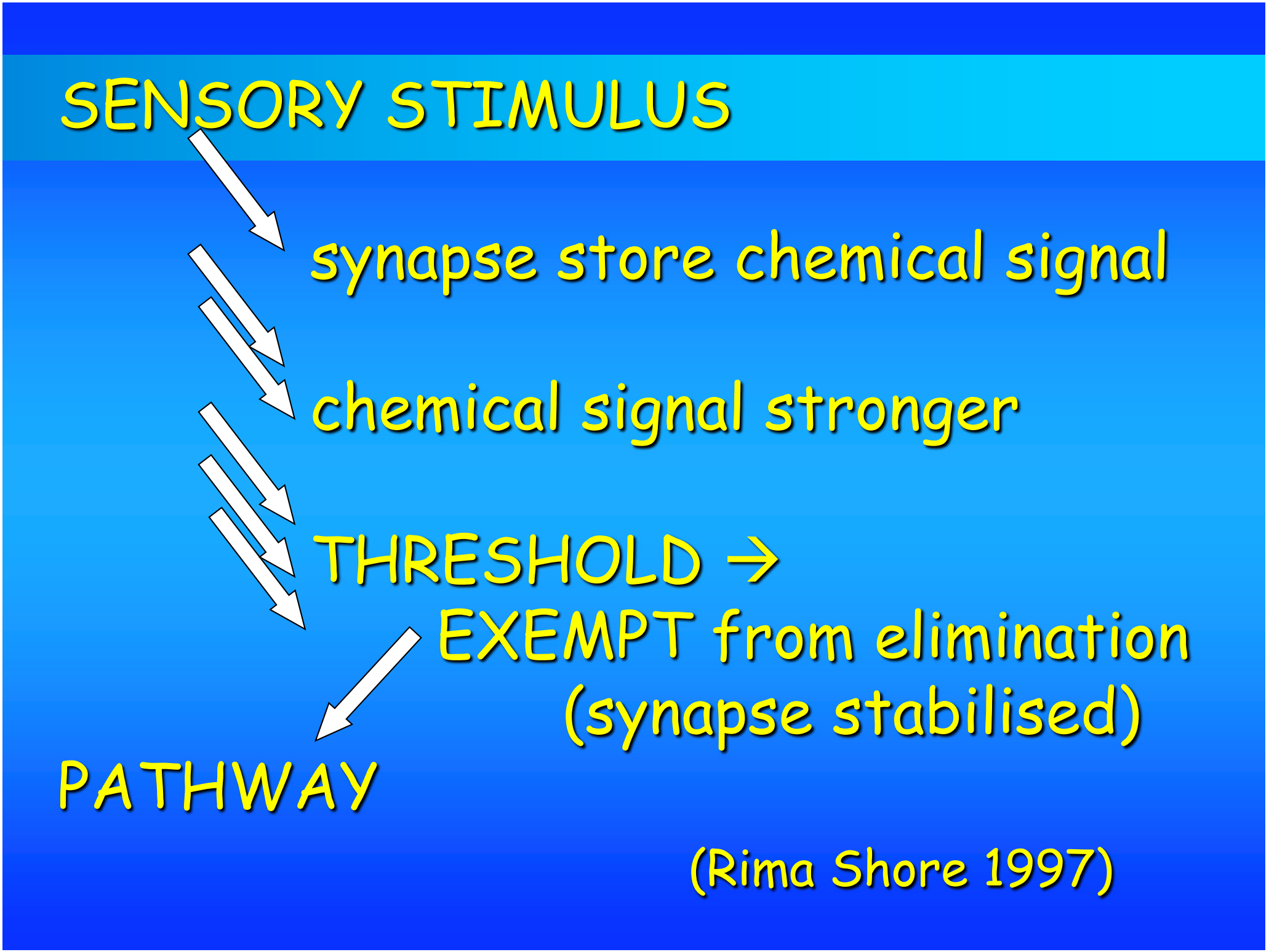
fetal REM sleep

(or active sleep) seems to be particularly important to the developing organism

… spontaneous synchronous firing

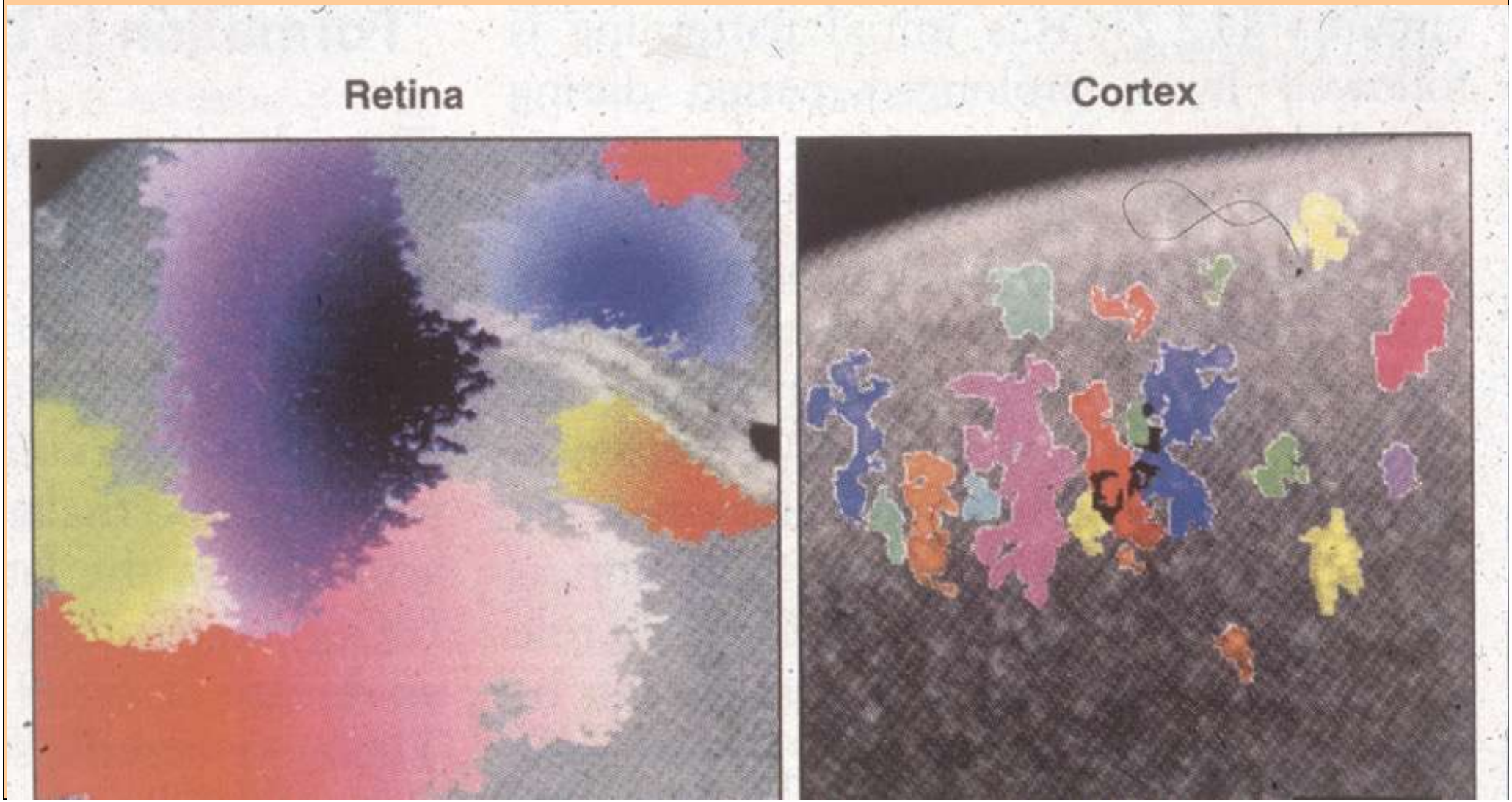
Marks et al 1995


Impulse
Presynaptic neuron
Vesicle
Transmitters
Synaptic cleft
Receptors
Postsynaptic neuron
Postsynaptic activity
©BrainConnection.com


SENSORY STIMULUS
synapse store chemical signal
chemical signal stronger
THRESHOLD →
EXEMPT from elimination
(synapse stabilised)
PATHWAY
(Rima Shore 1997)

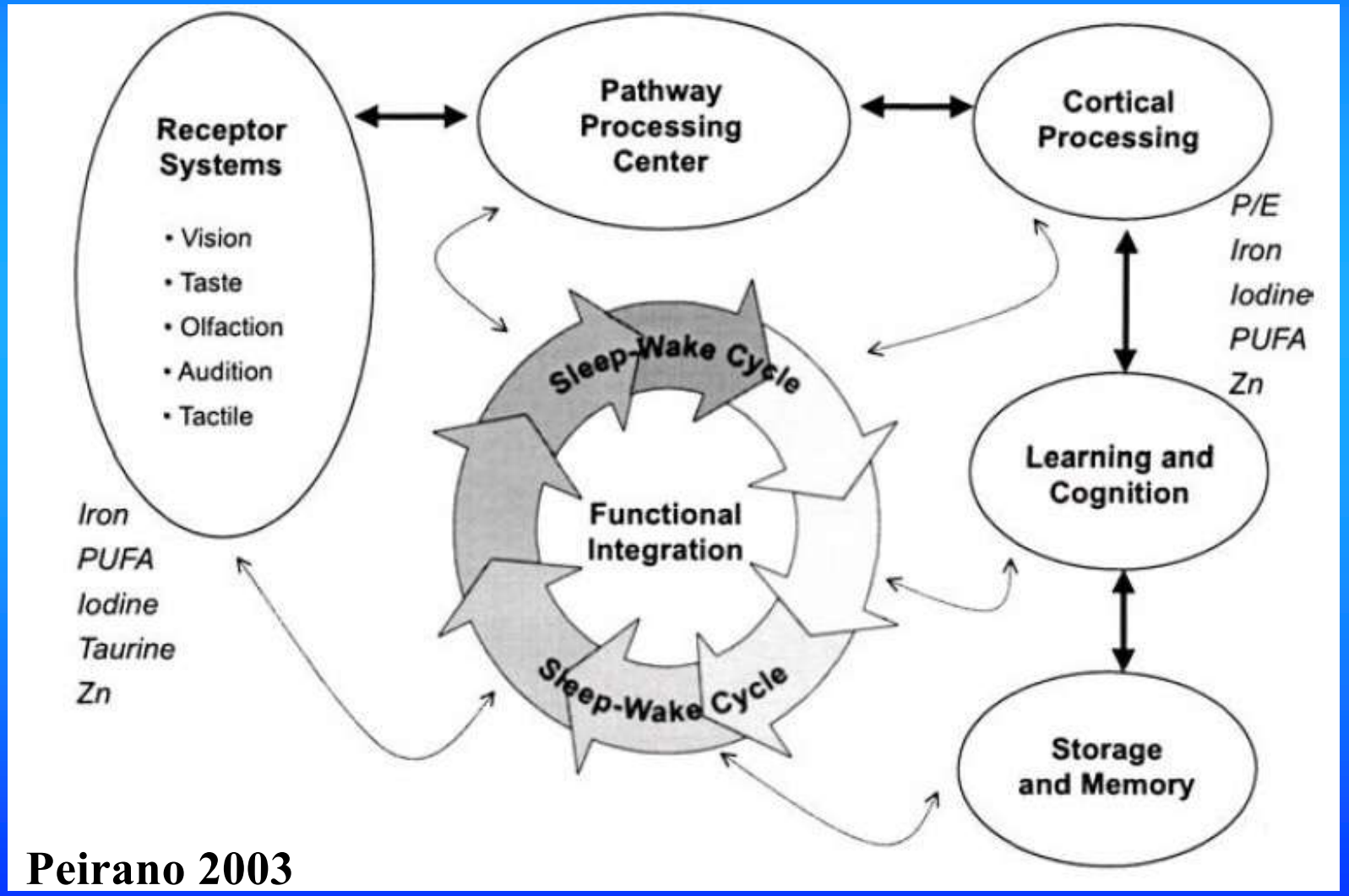
”Neurons that fire together wire together while those which don’t,won’t”

Hebb/Carla Shatz



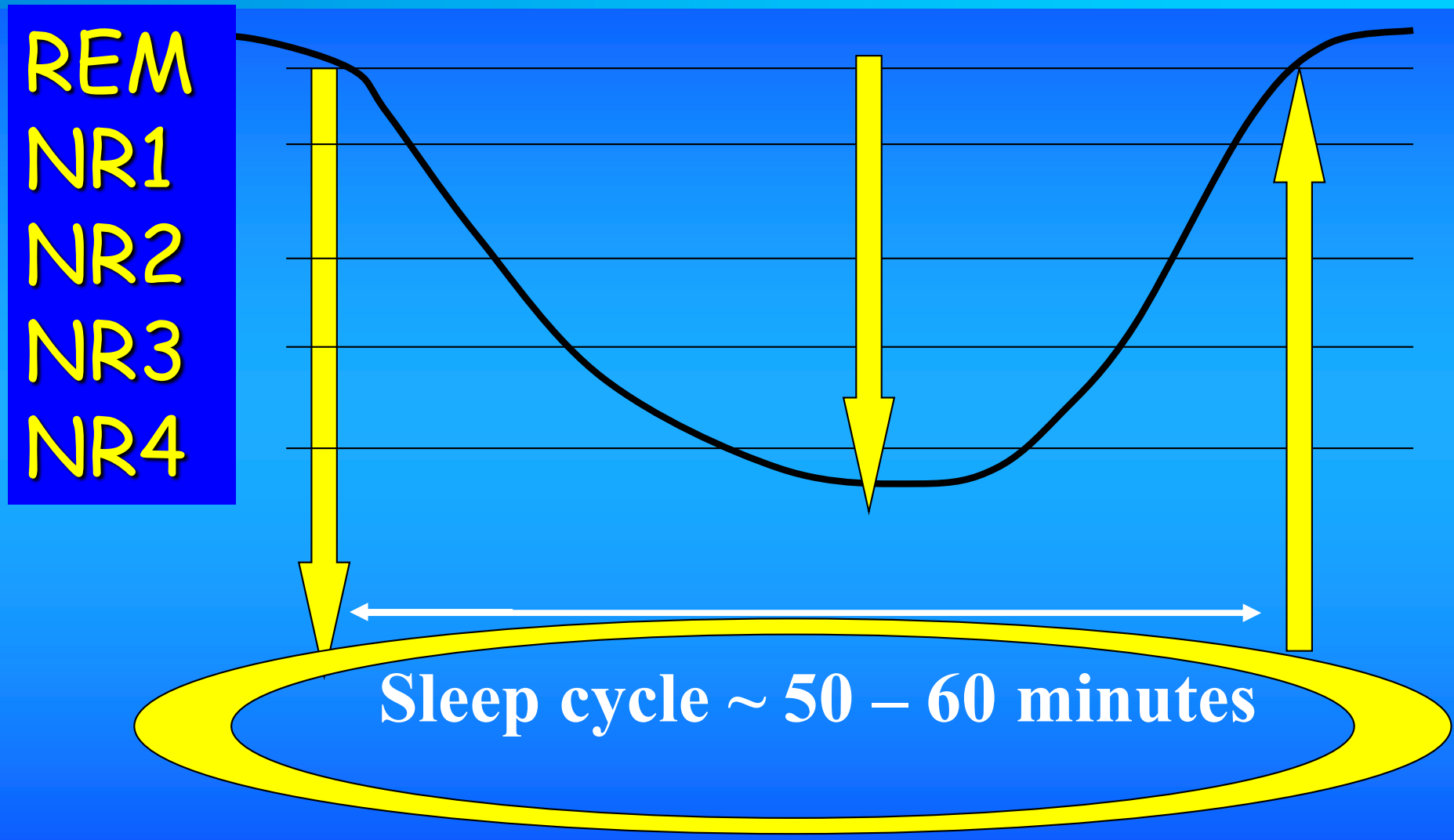
”Neurons that fire together wire together while those which don't,won't”

Hebb/Carla Shatz



Peirano 2003

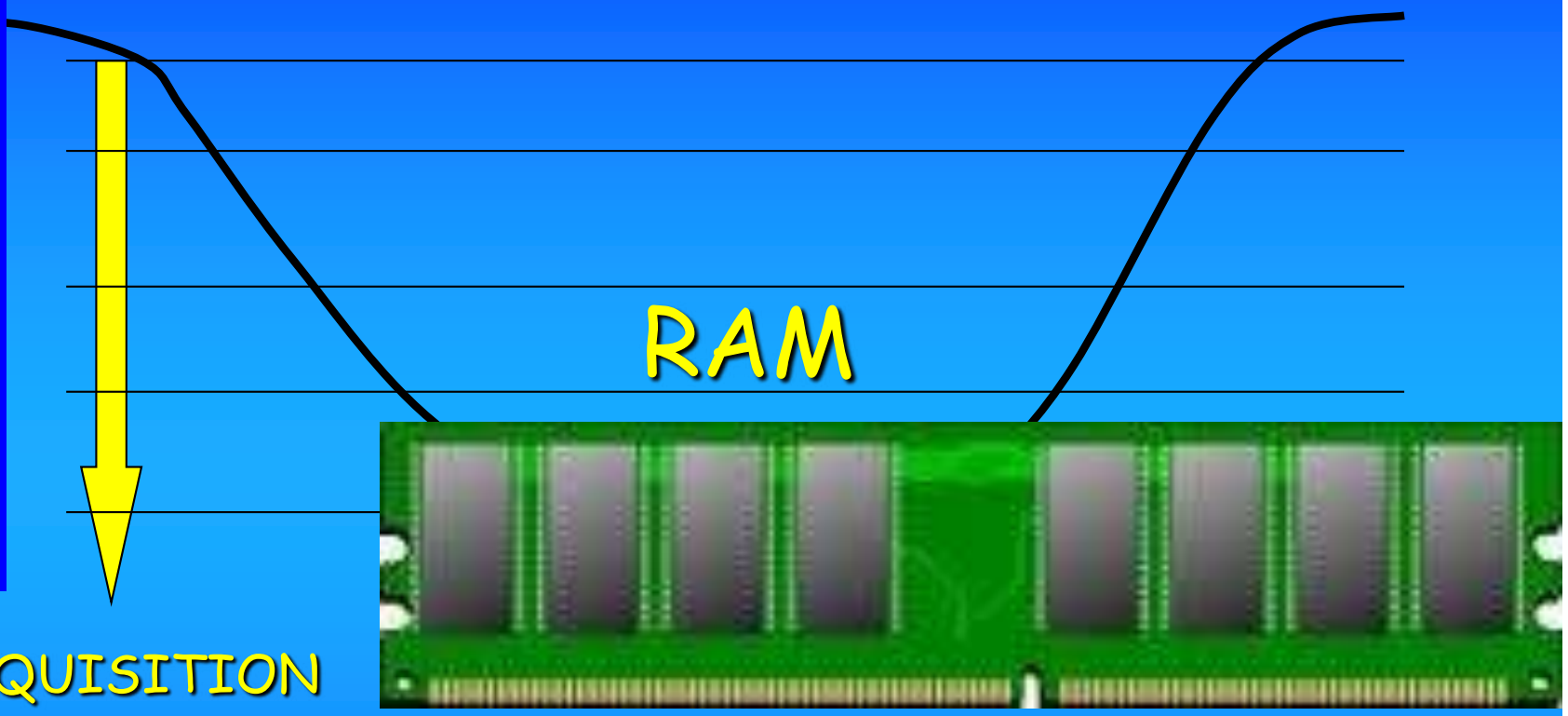
BRAIN WIRING



Stanley Graven 2006

ACQUISITION

REM
NR1
NR2
NR3
SWS



ACQUISITION

poly-sensory input
short-term memory
stored cortex

Awake and REM

Neocortex

consciousness
short term memory

GPS

HIPPOCAMPUS

Memory function and spatial code

AMYGDALA:

Emotional Processing Unit

Amodio 2008

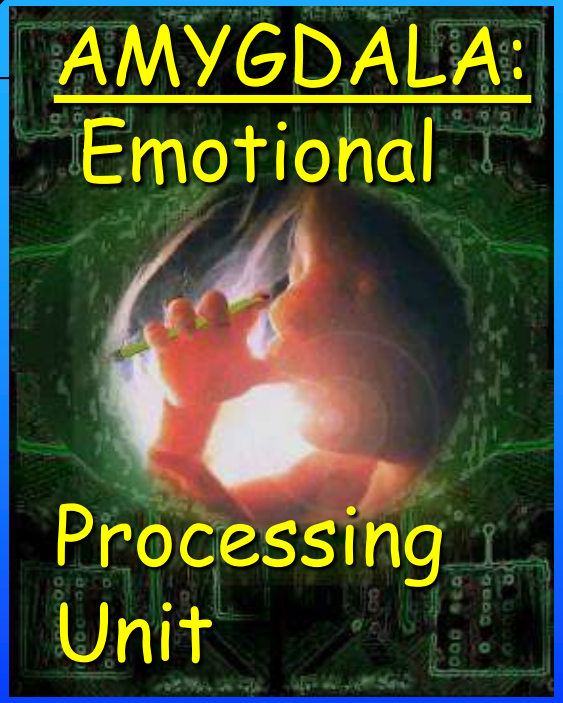
CONSOLIDATION

Amodio 2008

REM
NR1
NR2
NR3
SWS

CONSOLIDATION

transfer information
"SNR" strong signals
amygdala /
hippocampus
NREM stage 4



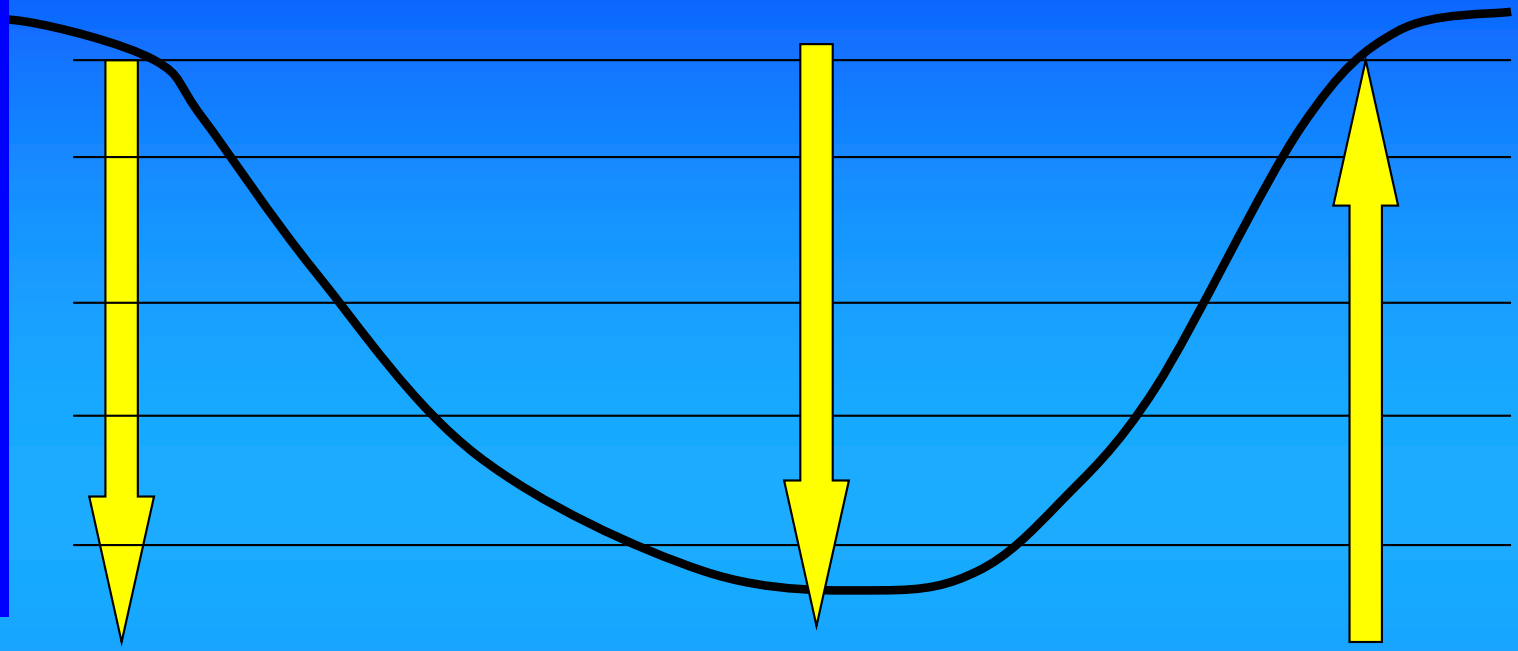
MEMORY FORMATION

REM
NR1
NR2
NR3
SWS

MEMORY FORMATION
P waves returns info to neocortex: organized REM

BRAIN WIRING

REM
NR1
NR2
NR3
SWS



ACQUISITION

poly-sensory input
short-term memory
stored cortex

Awake and REM

CONSOLIDATION

transfer information
"SNR" strong signals
amygdala / hippocampus
NREM stage 4

MEMORY FORMATION

P waves
returns info
to neocortex:
organized
REM

Sleep, Hormones, and Memory

Jan Born, PhD[a,*], Ullrich Wagner, PhD[b]

Obstet Gynecol Clin N Am 36 (2009) 809–829

This article follows the hypothesis that a primary function of sleep pertains to the consolidation of memory. In recent years, this view has received substantial support from a rapidly growing number of experiments performed in various species and at different levels of beh oral, cellular, and molecular analysis.[2–7]

In adult:
sleep pertains
to memory

Sleep, Hormones, and Memory

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Obstet Gynecol Clin N Am 36 (2009) 809–829

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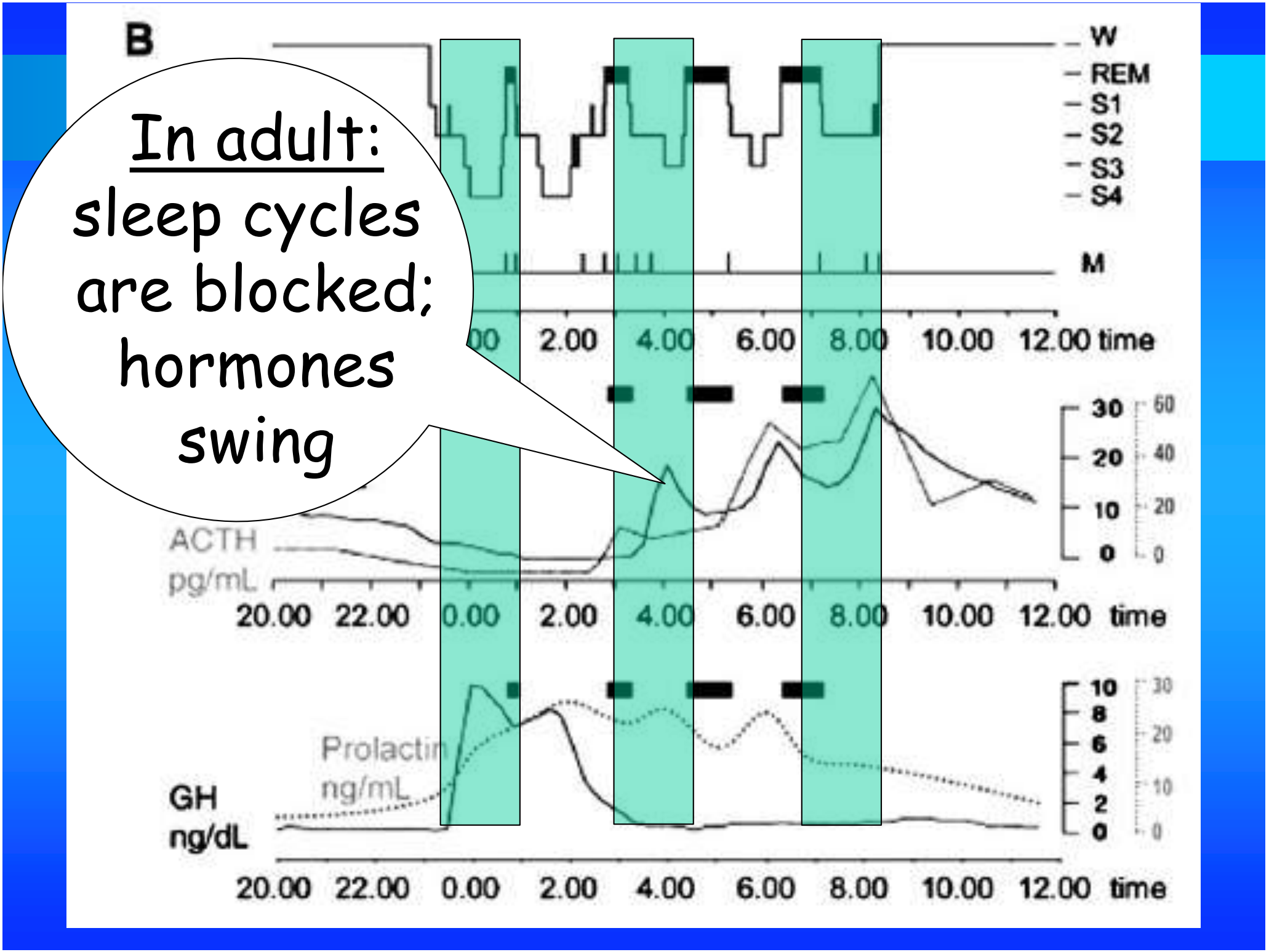
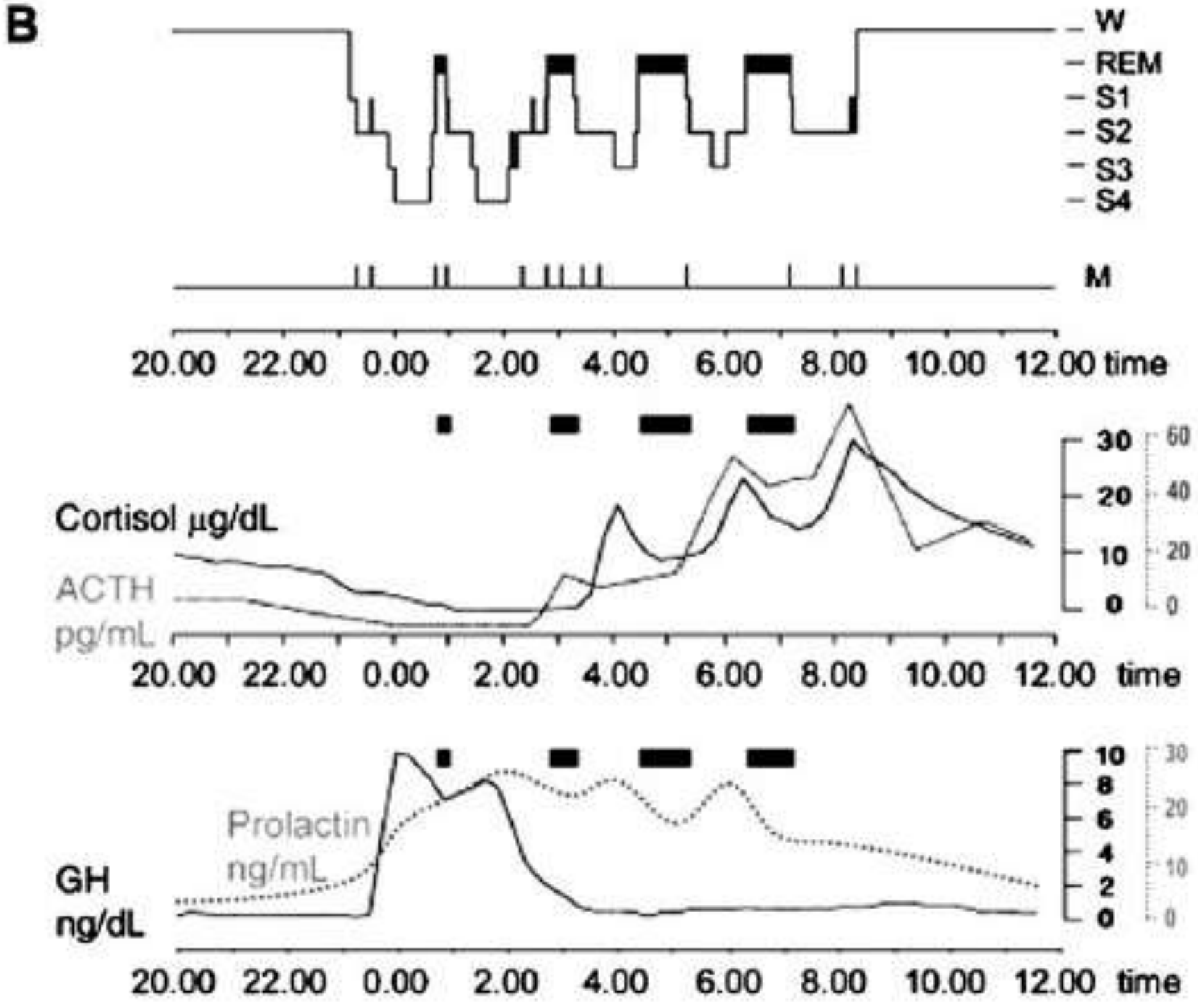
In adult:
sleep pertains to memory

In child:
neurodevelopment (brain wiring)
1st 1000 days


In adult:
sleep cycles are blocked; hormones swing
B
W
REM
S1
S2
S3
S4
M
2.00
4.00
6.00
8.00
10.00
12.00 time
30
20
10
0
60
40
20
0
ACTH
pg/mL
20.00
22.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
time
10
8
6
4
2
0
30
20
10
0
Prolactin
ng/mL
GH
ng/dL
20.00
22.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
time


B
W
REM
S1
S2
S3
S4
M
20.00 22.00 0.00 2.00 4.00 6.00 8.00 10.00 12.00 time
Cortisol µg/dL
ACTH
pg/mL
30
20
10
0
60
40
20
0
20.00 22.00 0.00 2.00 4.00 6.00 8.00 10.00 12.00 time
Prolactin
ng/mL
GH
ng/dL
10
8
6
4
2
0
30
20
10
0
20.00 22.00 0.00 2.00 4.00 6.00 8.00 10.00 12.00 time

Memory consolidation during sleep: Interactive effects of sleep stages and HPA regulation

Stress, January 2008; 11(1): 28–41

ULLRICH WAGNER & JAN BORN

SWS makes fact and episode (declarative) memory

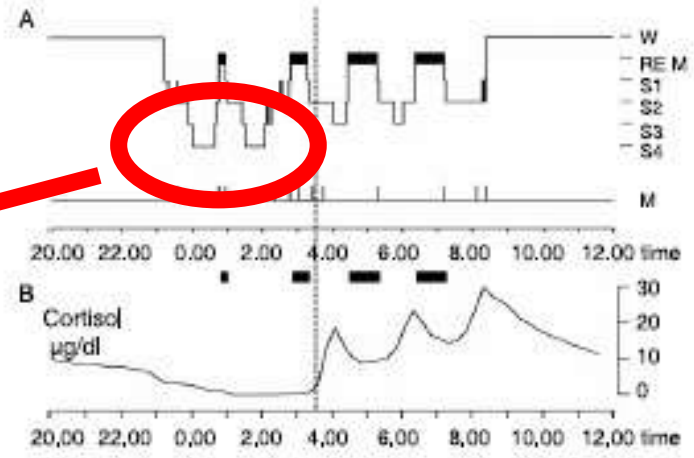


Figure 1. (A) Sleep profile (hypnogram) for a typical night of sleep, showing the nocturnal sequence of electrophysiologically defined sleep stages (REM sleep and Non-REM sleep stages S1–S4). The deepest sleep stages S3 and S4 indicate SWS, characterized by slowly oscillating activity (<4 Hz) in the EEG. SWS and REM sleep are not equally distributed across the night. While sleep in the first half of the night (left from vertical line) is dominated by SWS, sleep in the second half of the night (right from vertical line) contains high amounts of REM sleep. *W*, wake; *M*, movement activity. (B) Due to circadian and sleep-dependent regulation (see text), cortisol release is strongly suppressed during early sleep, but increases distinctly during late sleep, reaching a maximum in the early morning hours. Accordingly, SWS-dominated early is accompanied by minimal levels of circulating cortisol, while basal cortisol levels are high during REM sleep-dominated late sleep. These changing patterns of electrophysiological and endocrine activity across nocturnal sleep interactively affect memory consolidation.

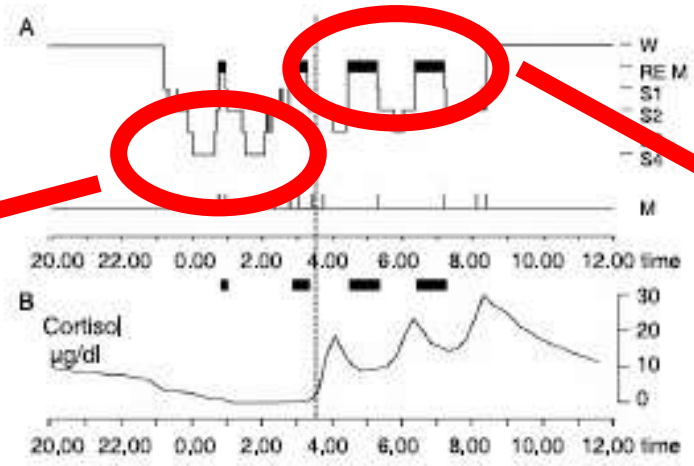
Memory consolidation during sleep: Interactive effects of sleep stages and HPA regulation

Stress, January 2008; 11(1): 28–41

ULLRICH WAGNER & JAN BORN

CORTISOL

SWS makes fact and episode (declarative) memory



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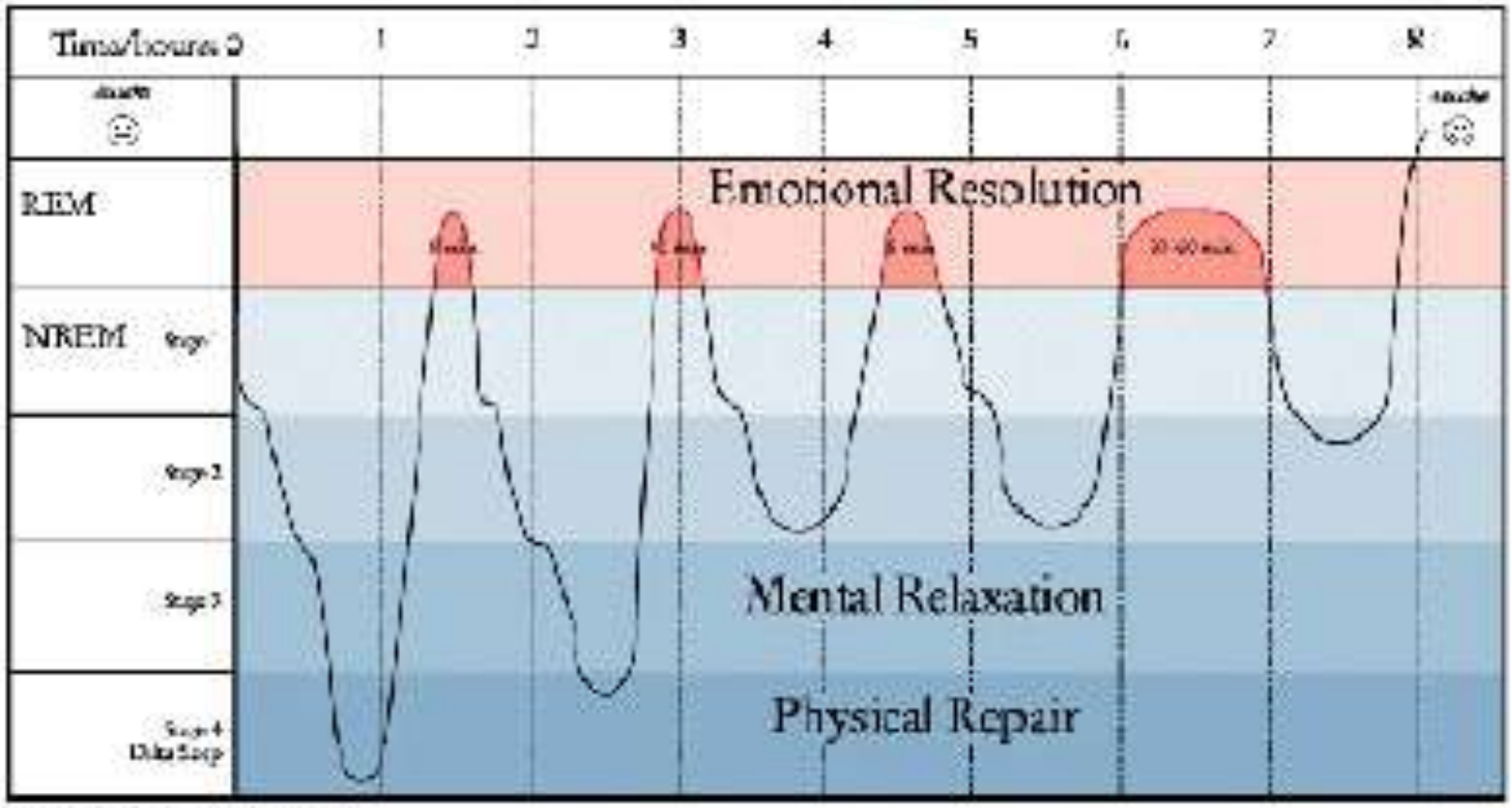
REM sleep makes emotional memory

Also skills

CORTISOL protects Ffrom negative embedding in REM

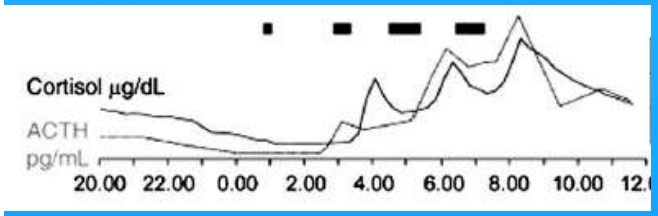
The Natural Sleep Process



Joseph 2014

Arch Dis Child Fetal Neonatal Ed. 2014 Sep 22. pii: fetalneonatal-2014-306104.
doi: 10.1136/archdischild-2014-306104. [Epub ahead of print]

Getting rhythm: how do babies do it?



CORTISOL
day-night
rhythm

Birth ~ /~ 8w 9w 10w 11w

dates averaged → "between 6 and 18 weeks"

Joseph 2014

Arch Dis Child Fetal Neonatal Ed. 2014 Sep 22. pii: fetalneonatal-2014-306104.
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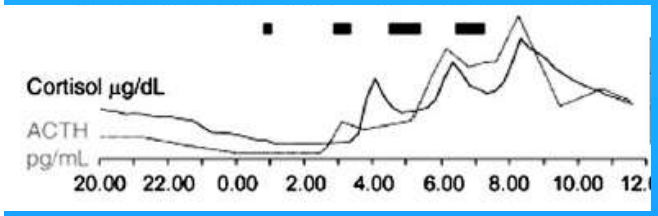

MELATONIN
day-night rhythm

CORTISOL
day-night
rhythm

Birth ~ /~ 8w 9w 10w 11w

dates averaged → "between 6 and 18 weeks"

Joseph 2014

Arch Dis Child Fetal Neonatal Ed. 2014 Sep 22. pii: fetalneonatal-2014-306104. doi: 10.1136/archdischild-2014-306104. [Epub ahead of print]

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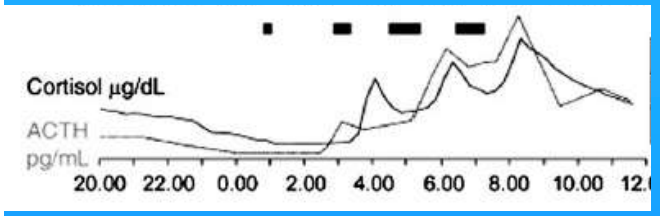


MELATONIN
day-night rhythm

CORTISOL
day-night rhythm

TEMPERATURE
day-night rhythm

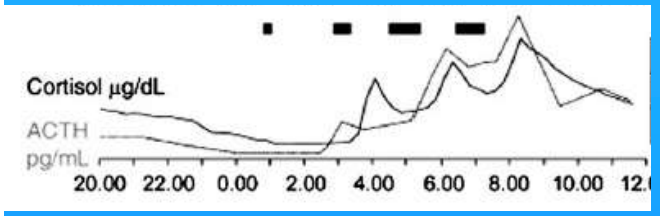
Birth ~ /~ 8w 9w 10w 11w

dates averaged → "between 6 and 18 weeks"

Joseph 2014

Arch Dis Child Fetal Neonatal Ed. 2014 Sep 22. pii: fetalneonatal-2014-306104.
doi: 10.1136/archdischild-2014-306104. [Epub ahead of print]

Getting rhythm: how do babies do it?



MELATONIN
day-night rhythm

H3f3b gene detected

CORTISOL
day-night rhythm

TEMPERATURE
day-night rhythm

Birth ~ /~ 8w 9w 10w 11w

dates averaged → "between 6 and 18 weeks"

Mother-infant synchrony

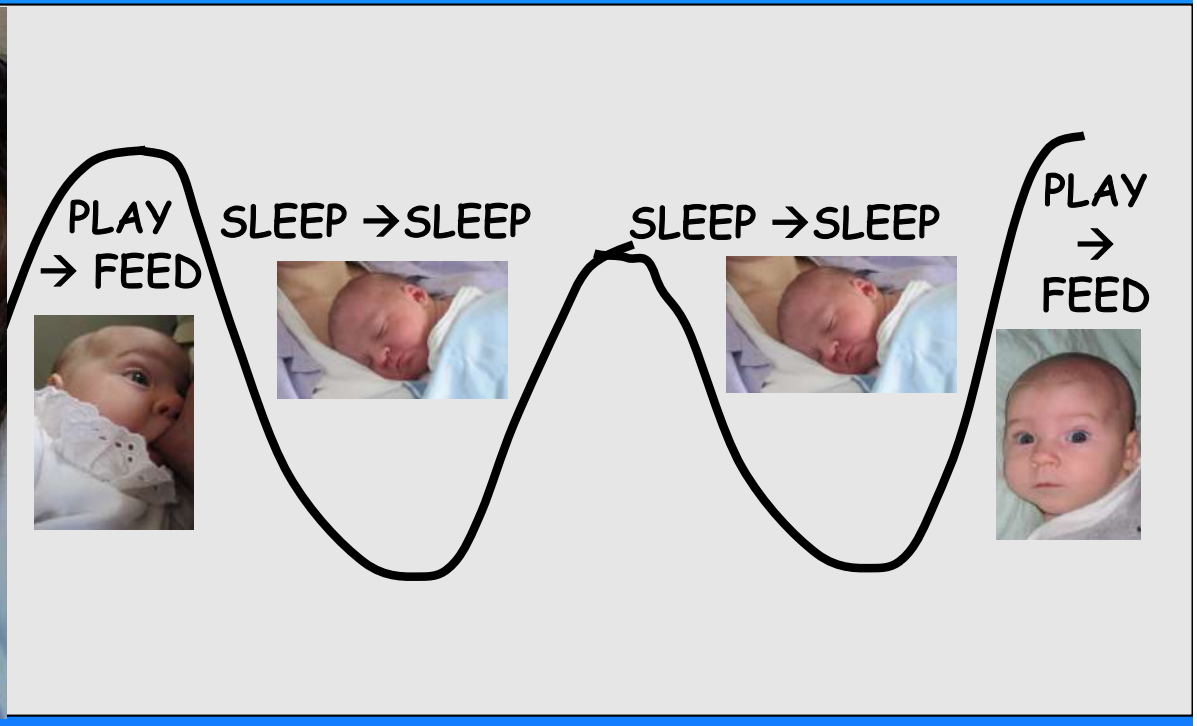
… at 12 weeks
(circadian) **Thomas 2014**

START at 3 months

Can be "adult-like"
at 6 months.

Infant:
sleep cycles begin to block on diurnal rhythms

Infant sleep cycling and synchronicity with maternal sleep ensure development.



Infant sleep cycling and synchronicity with maternal sleep ensure development.

Infant sleep cycling and synchronicity with maternal sleep ensure development.

Infant sleep cycling → critical for brain development,

BUT is also determined by brain requirements:

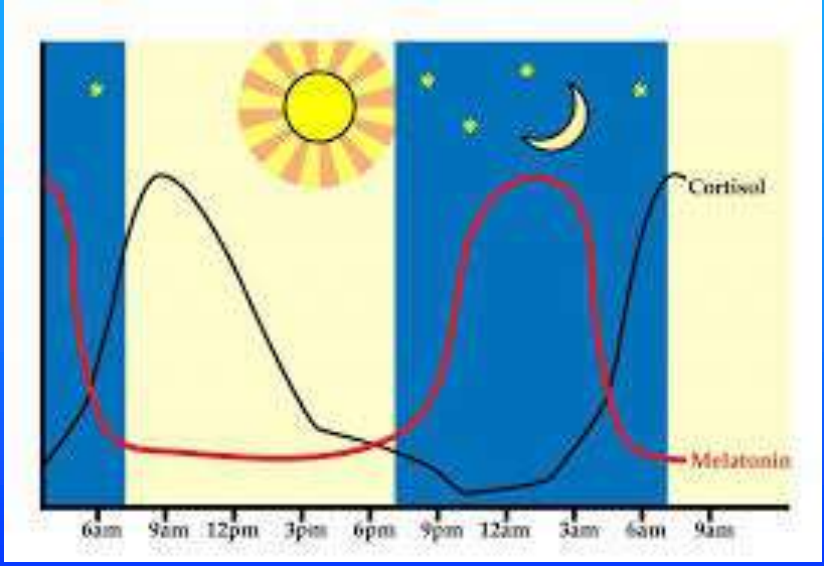
TEMPERAMENT

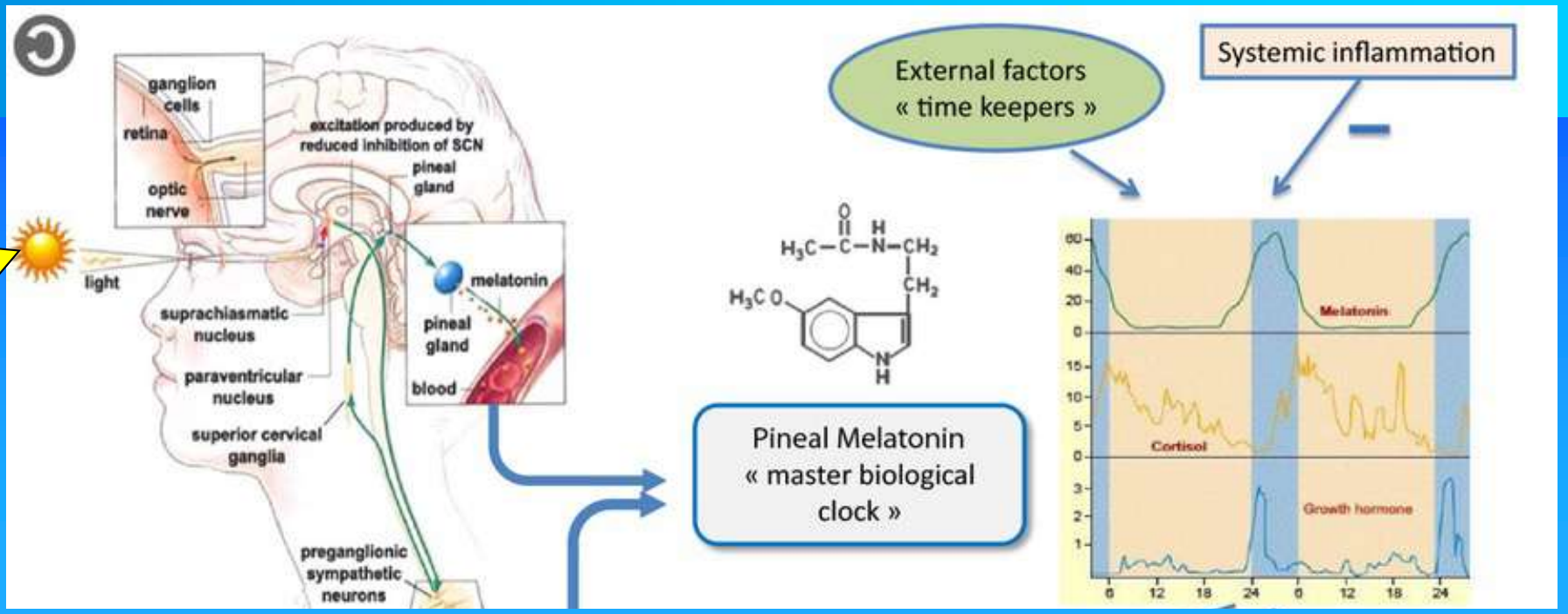
PERSONALITY

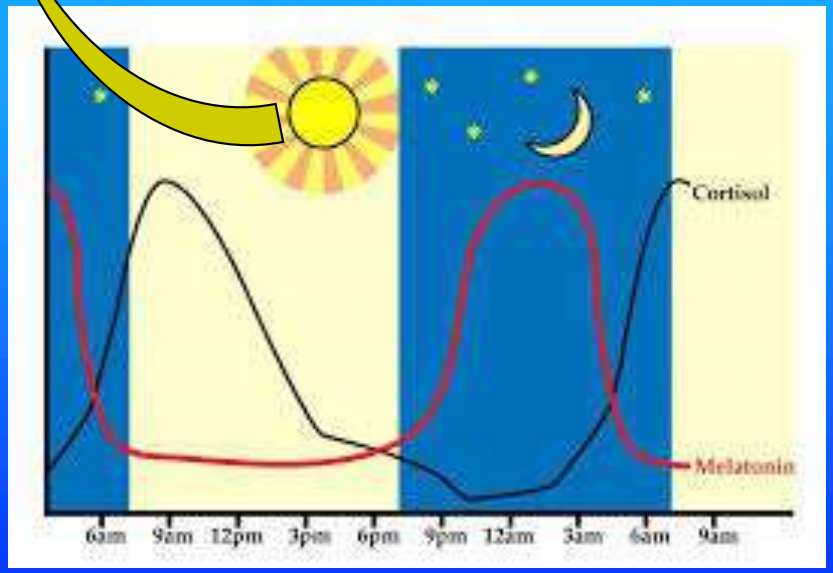
OREXIN METABOLISM

"MORE SLEEP → MORE WIRING"

Infant sleep cycling
→ critical for brain development,
BUT is also determined by brain requirements:





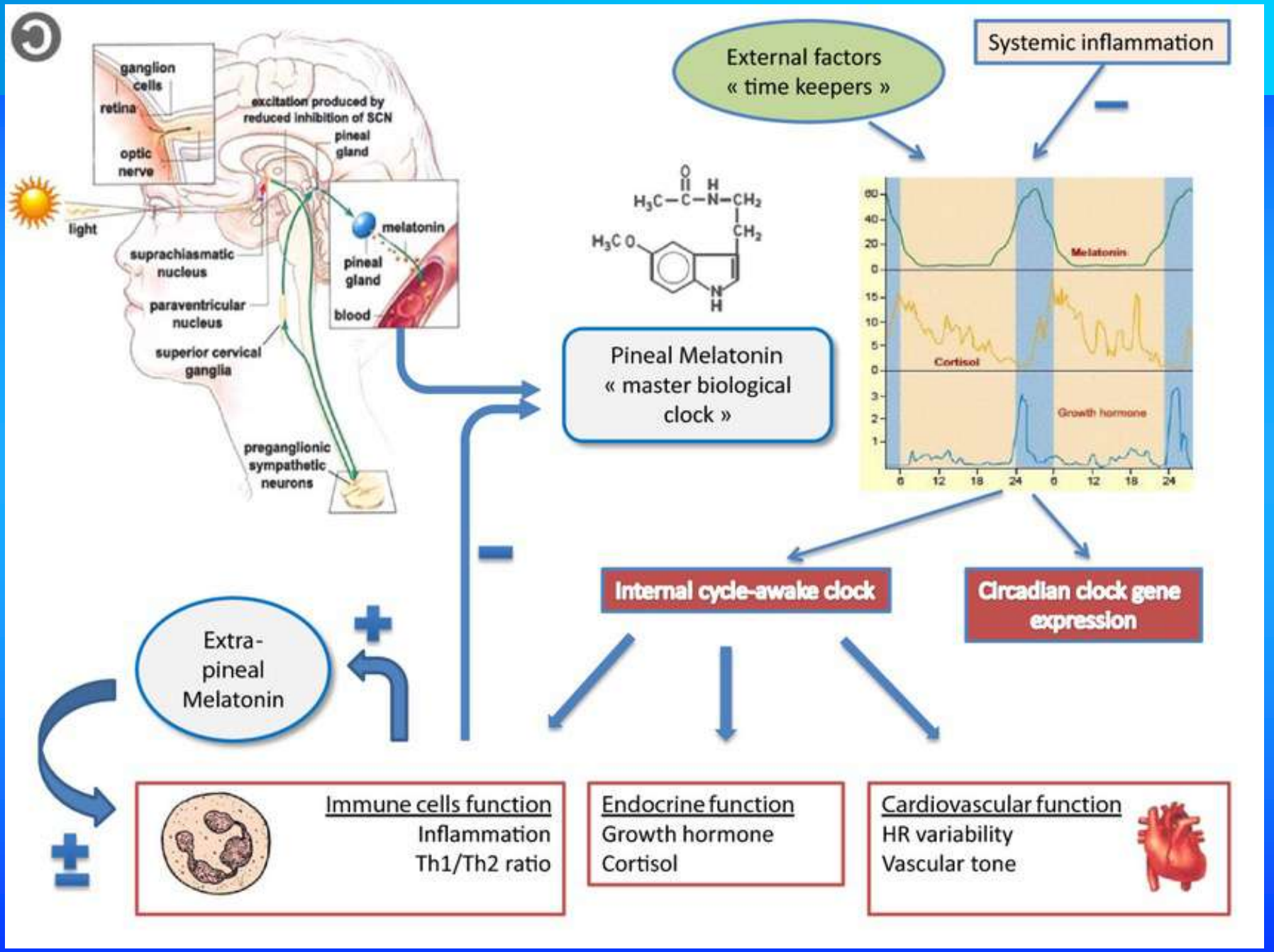


CIRCADIAN RHYTHM

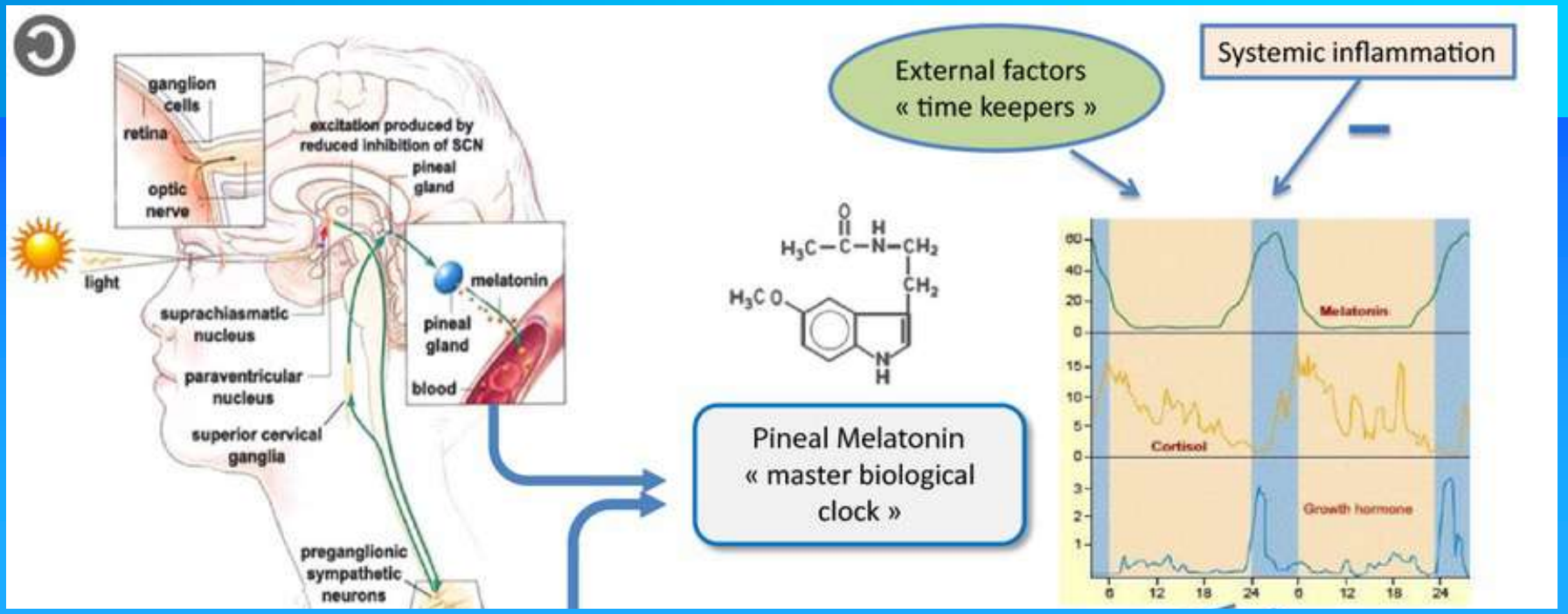
SCN

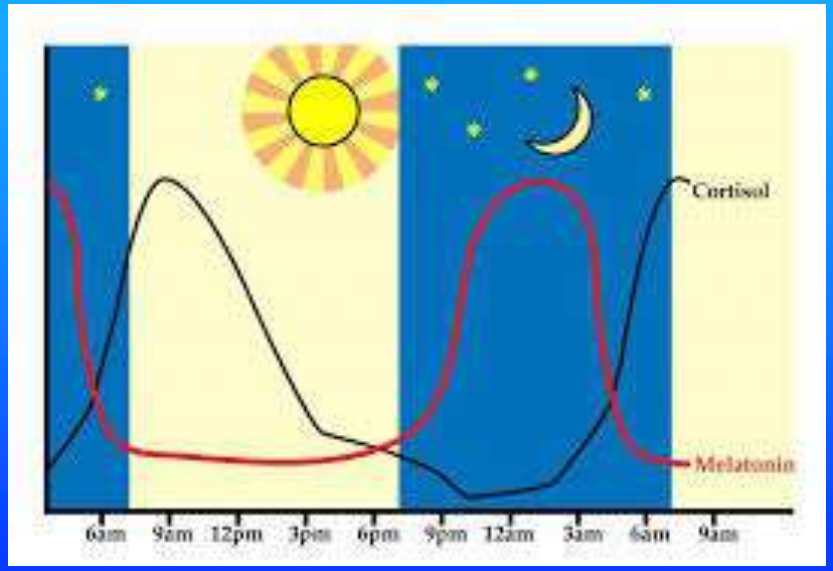
Suprachiasmatic nucleus,

Pineal gland, melatonin



https://www.researchgate.net/figure/Melatonin-the-master-biological-clock-Non-visual-effects-of-light-are-mediated-thr_fig1_263104171



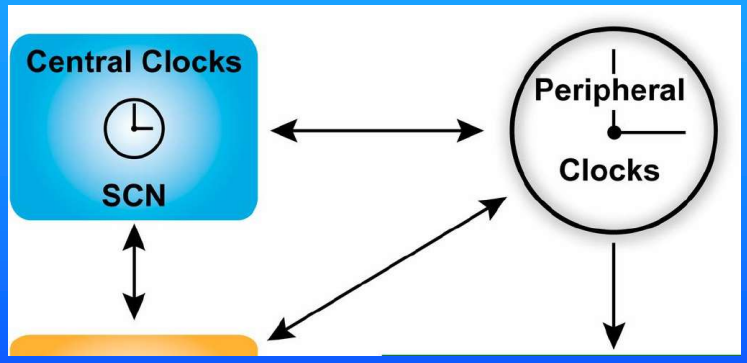


CIRCADIAN RHYTHM

Master clock,
sets other clocks
'***zeitgeber***'

Human clock genes.

Rhythmic variations in physiological and behavioural processes are mediated by both endogenous and exogenous factors. Endogenous factors include self-sustaining biological pacemakers or clocks which in the absence of strong external influences …



CIRCADIAN RHYTHM

Master clock,
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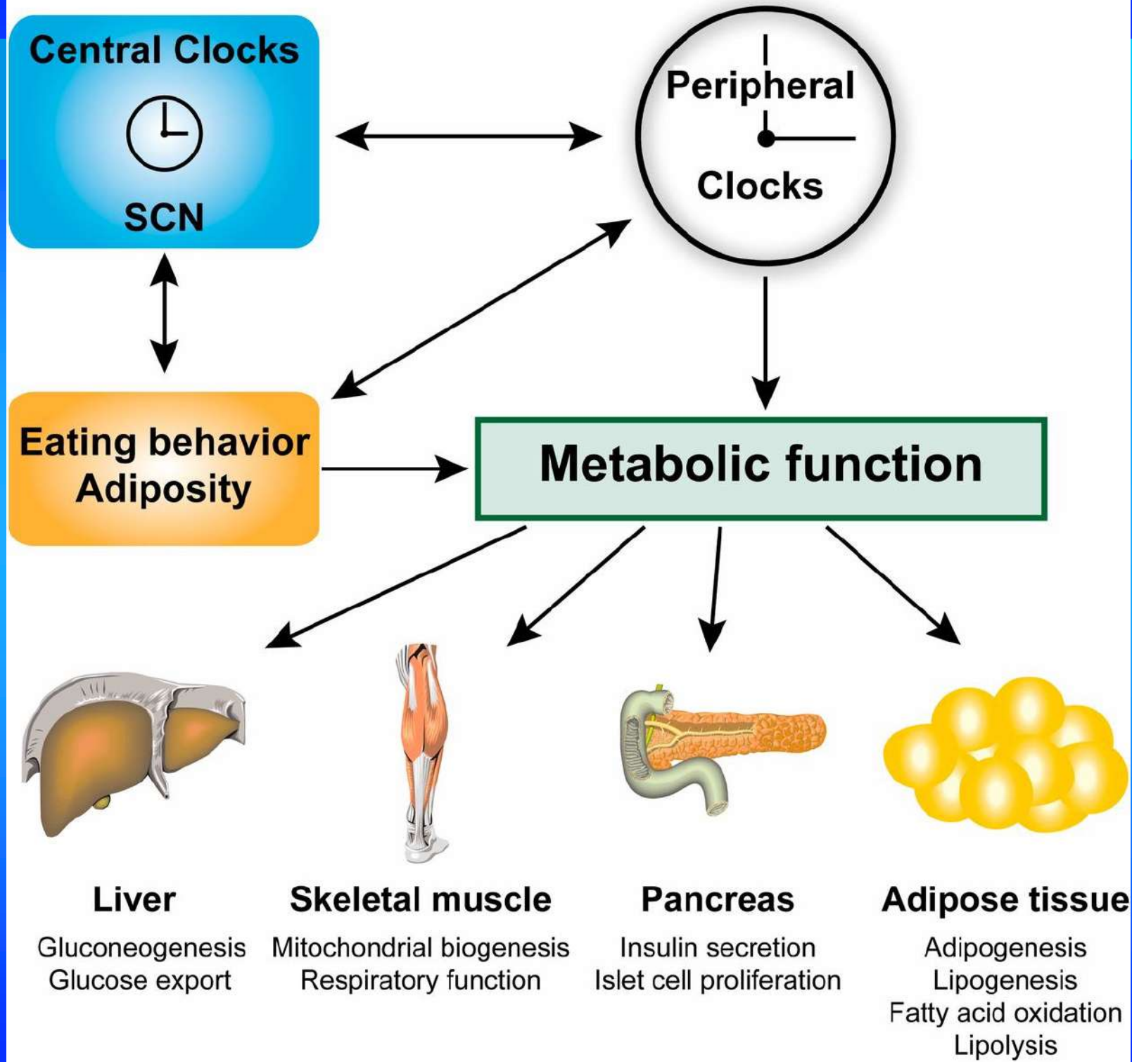
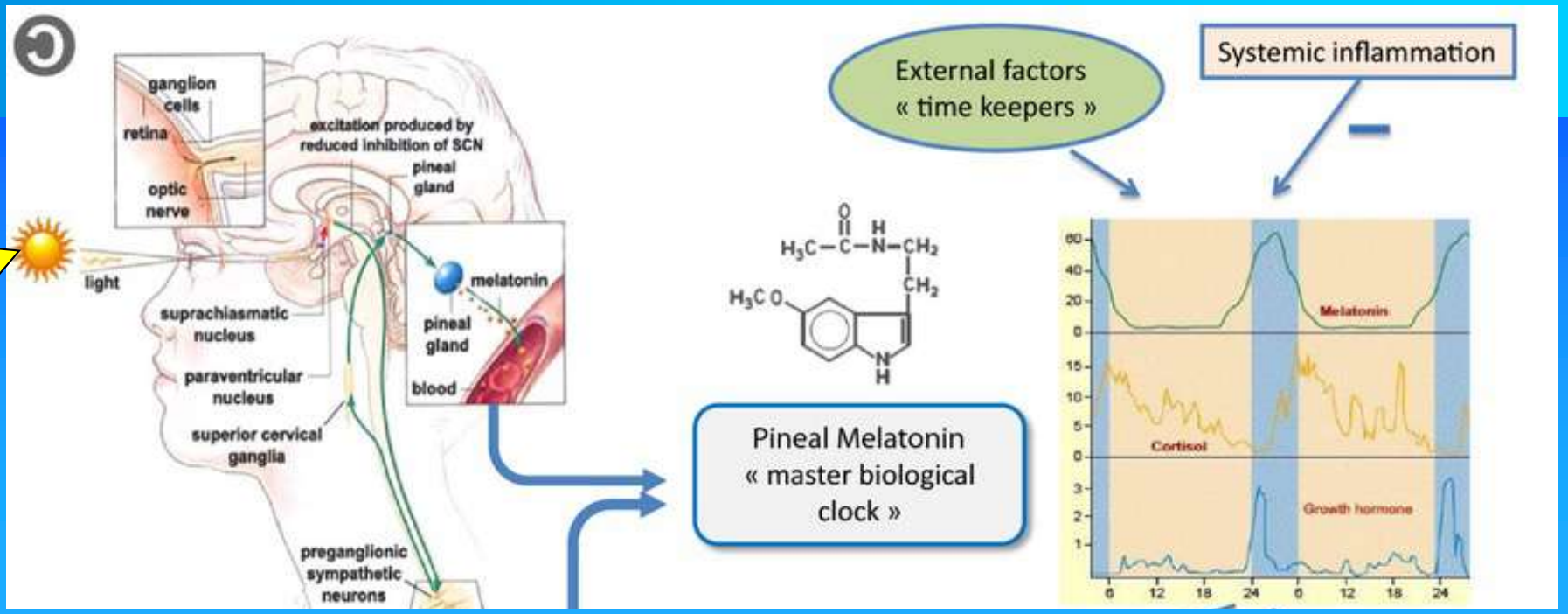
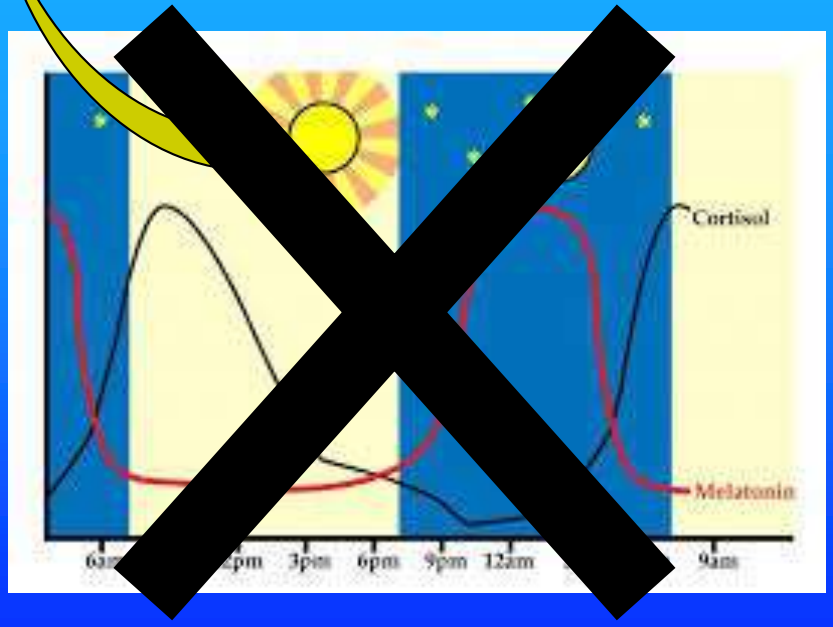
'***zeitgeber***'

Piggins HD 2002. Ann Med. 34(5):394-400.


Central Clocks
SCN
Peripheral
Clocks
Eating behavior
Adiposity
Metabolic function
Liver
Gluconeogenesis
Glucose export
Skeletal muscle
Mitochondrial biogenesis
Respiratory function
Pancreas
Insulin secretion
Islet cell proliferation
Adipose tissue
Adipogenesis
Lipogenesis
Fatty acid oxidation
Lipolysis



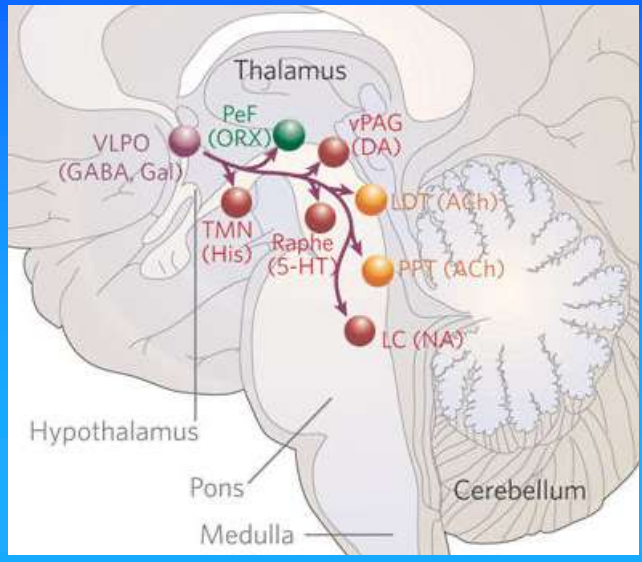


CIRCADIAN RHYTHM

ABSENT IN NEONATES

Ultradian and circadian rhythms

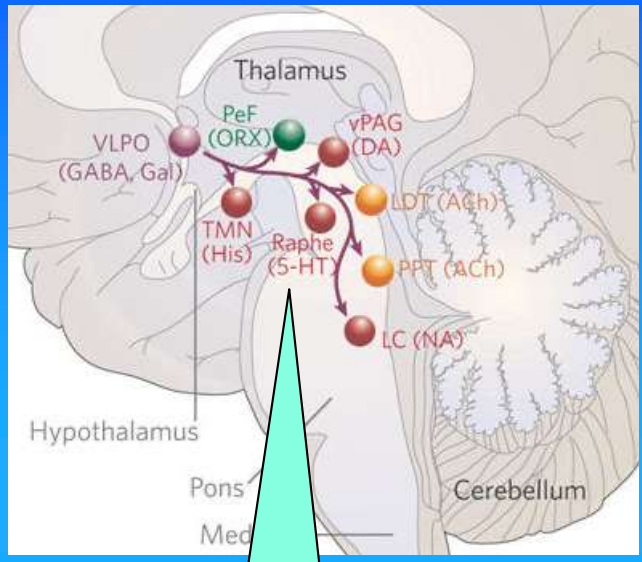
Ultradian:
Repeated during (single circadian) 24 hour period



Lohr B, Siegmund R. 1999. *Chronobiol Int* **16**(2): 129-48.

Ultradian and circadian rhythms of sleep-wake and food-intake behavior during early infancy.

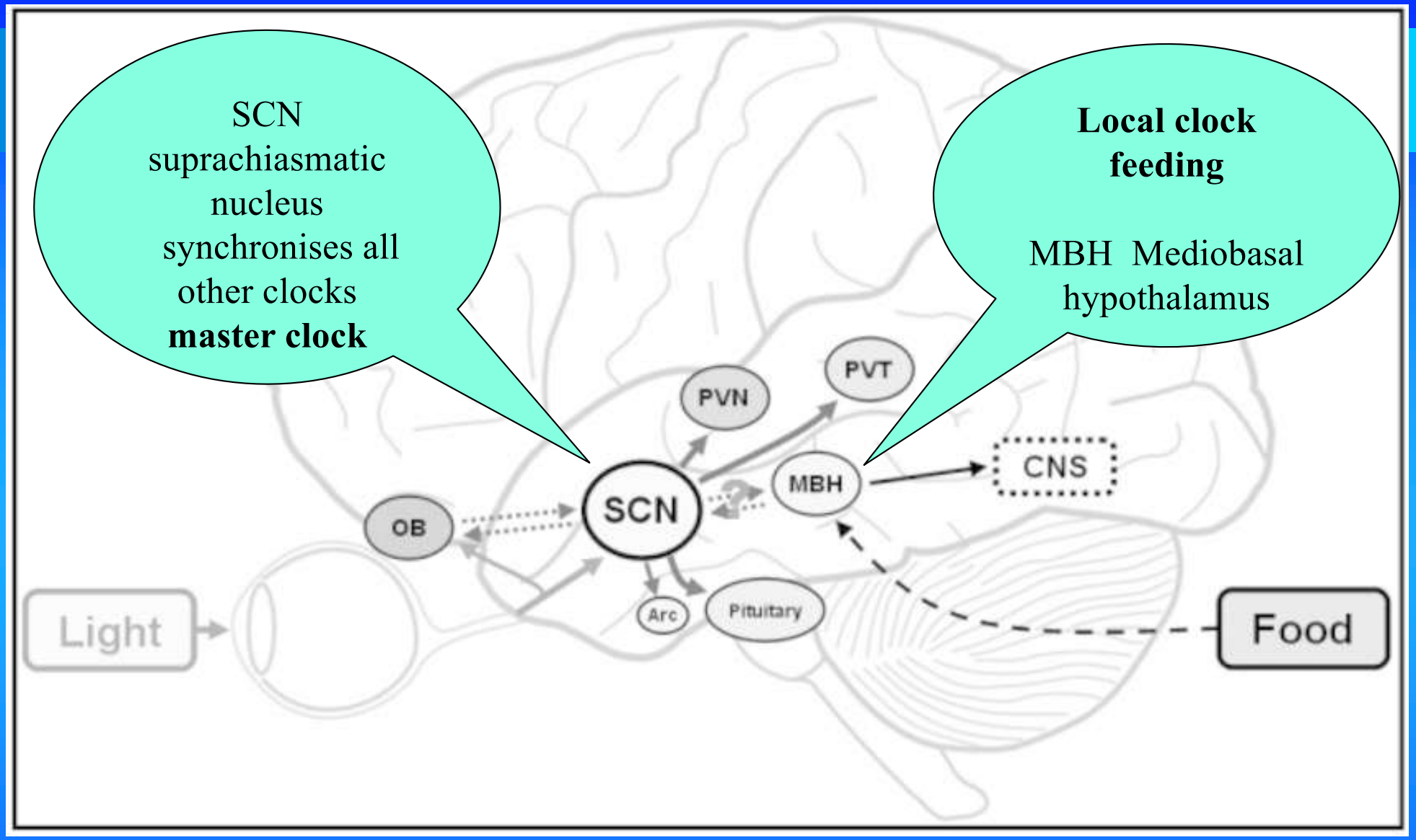
Ultradian:
Repeated during (single circadian) 24 hour period



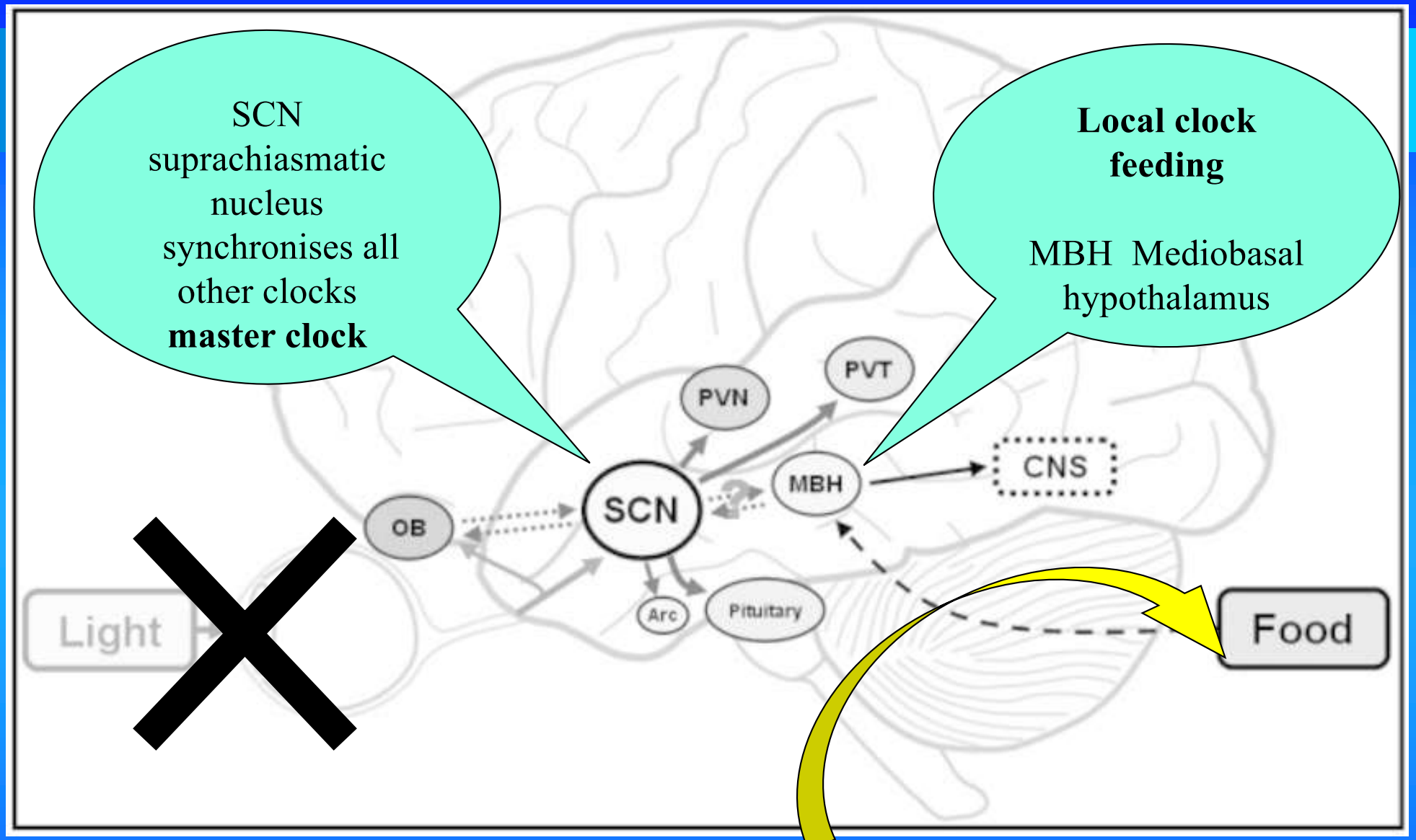
Pleasurable feeding - and sleeping -

Lohr B, Siegmund R. 1999. *Chronobiol Int* **16**(2): 129-48.

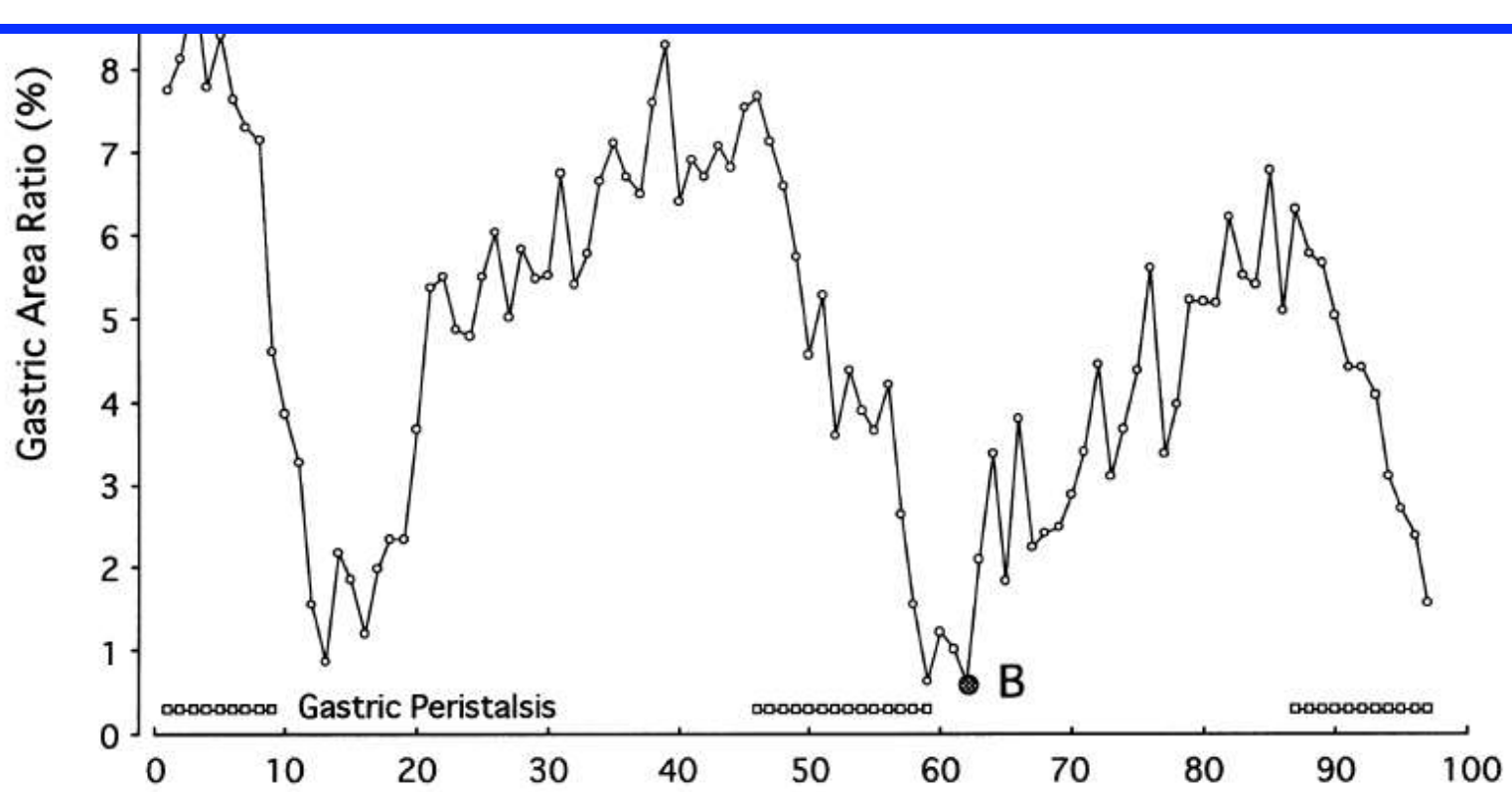
Hypothalamic local clocks communicate and coordinate



https://www.researchgate.net/figure/Circadian-clocks-in-the-SCN-and-other-regions-of-the-brain-In-addition-to-the-central_fig3_51823898



The 'zeitgeber' is not light, it is feeding.



note rhythmicity
of fetal stomach → 40 – 50 minutes

The 'zeitgeber' is
not light, it is feeding.

Gastric clock: 40-50 minutes

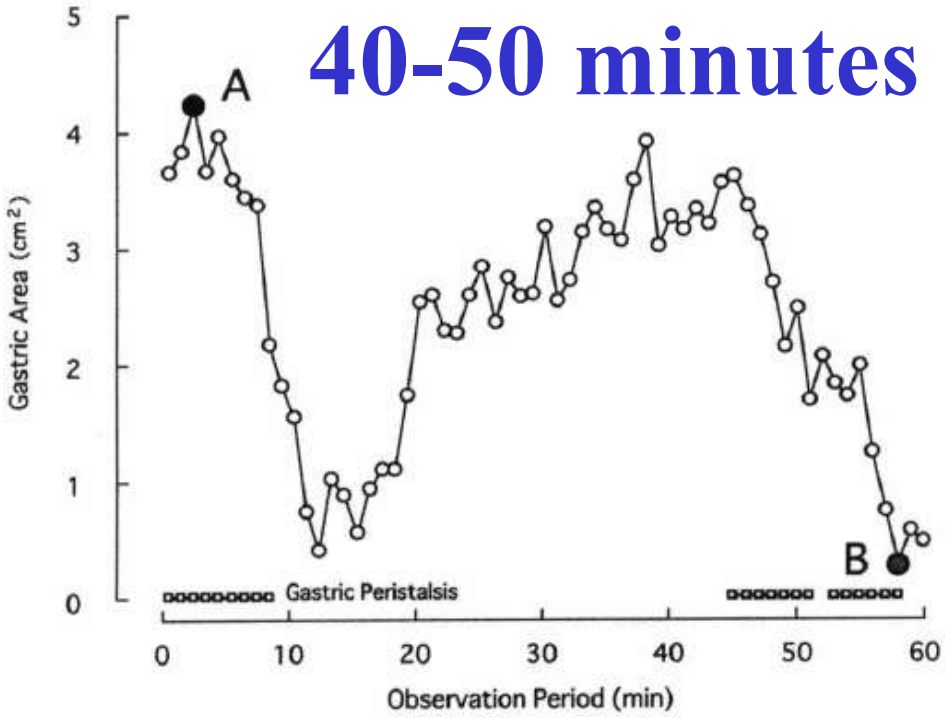
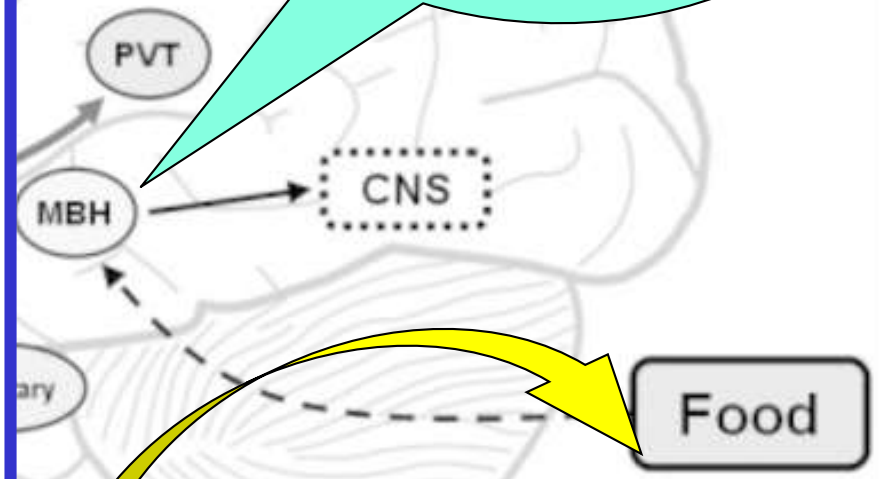


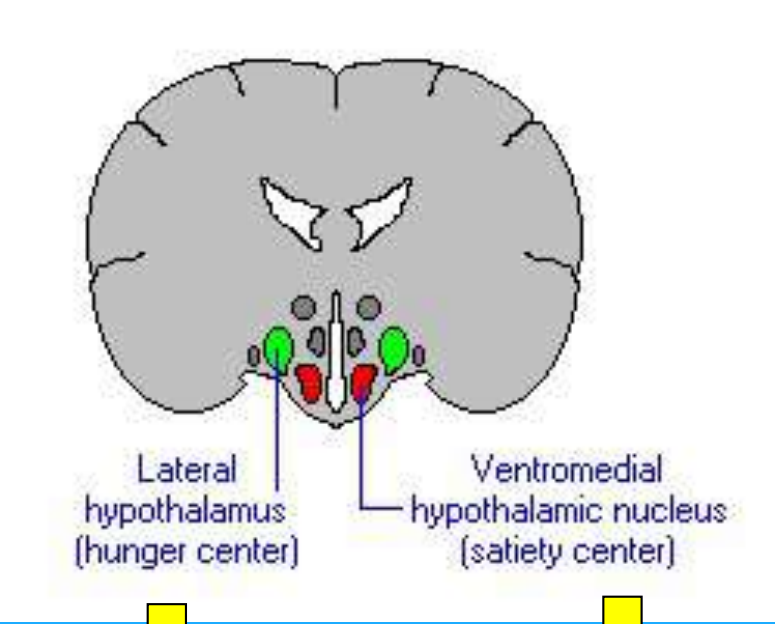
Figure 2. Changes of gastric area in a representative fetus at 33 weeks of gestation, in association with gastric peristalsis. The maximum gastric area (A) and the minimum gastric area (B) [27].

Local clock feeding

MBH Mediobasal hypothalamus

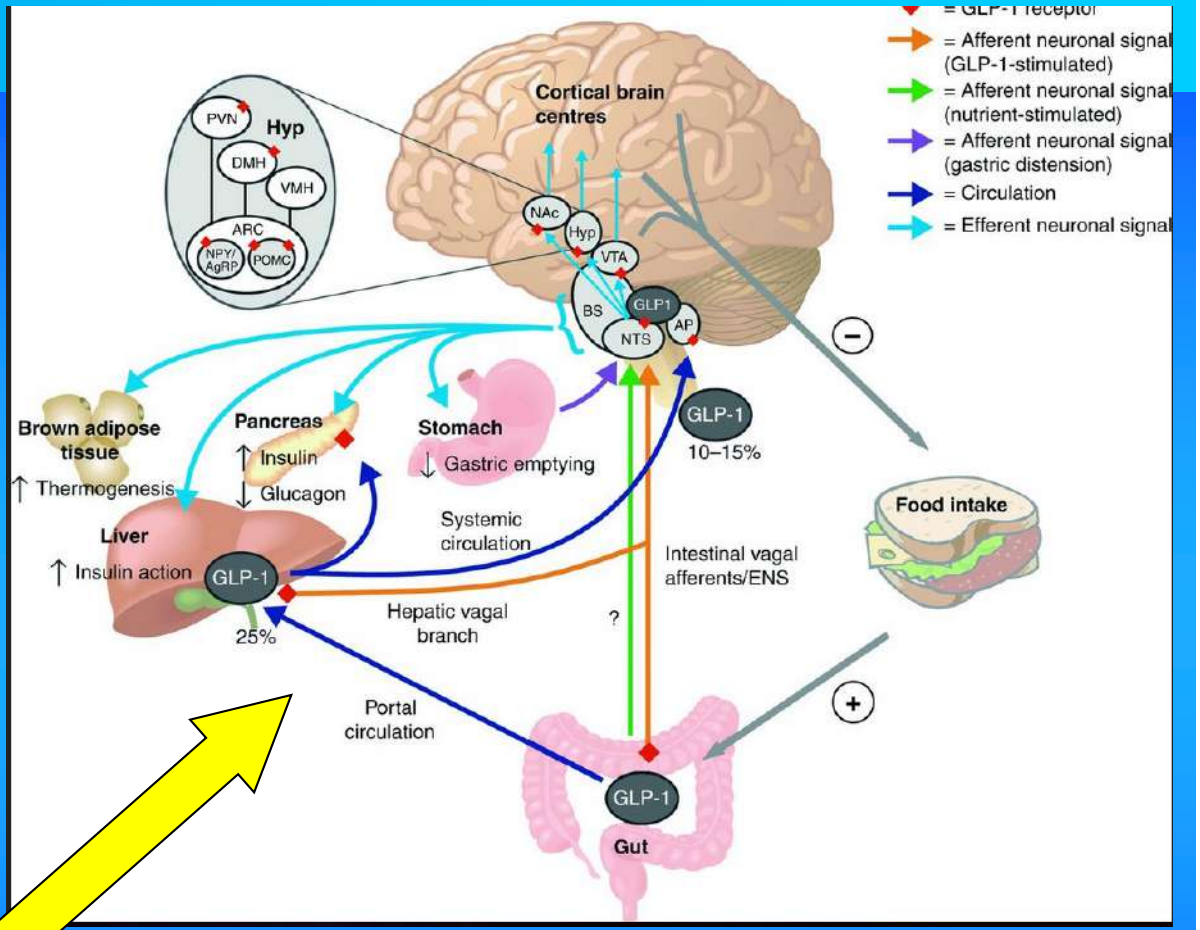


The 'zeitgeber' is not light, it is feeding.

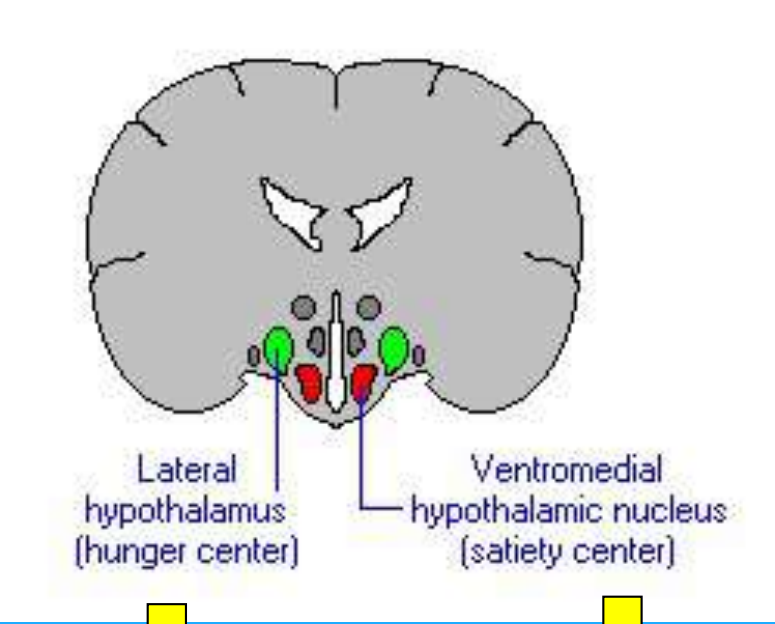


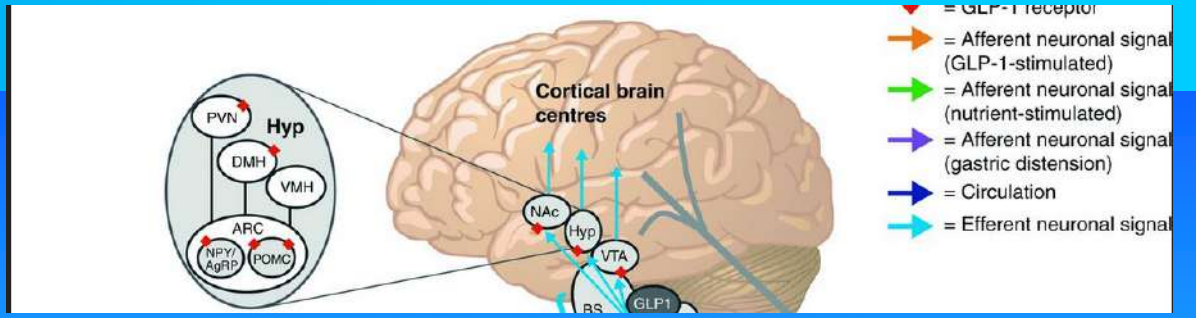
Hunger & Satiety rhythms

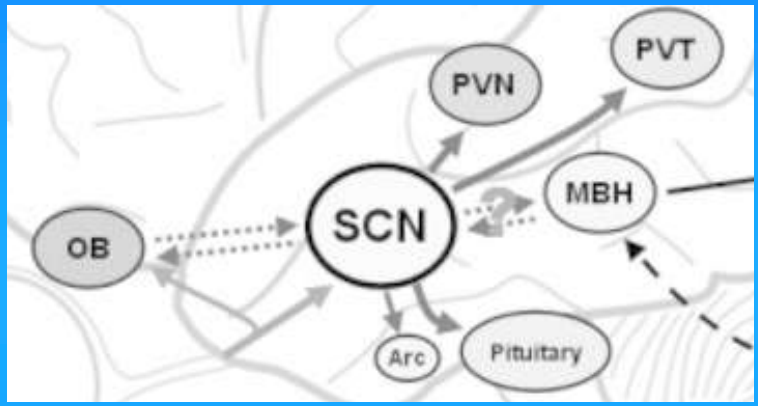
regulate all metabolic processes



http://joe.endocrinology-journals.org/content/221/1/T1/F1.expansion.html







Hunger & Satiety rhythms

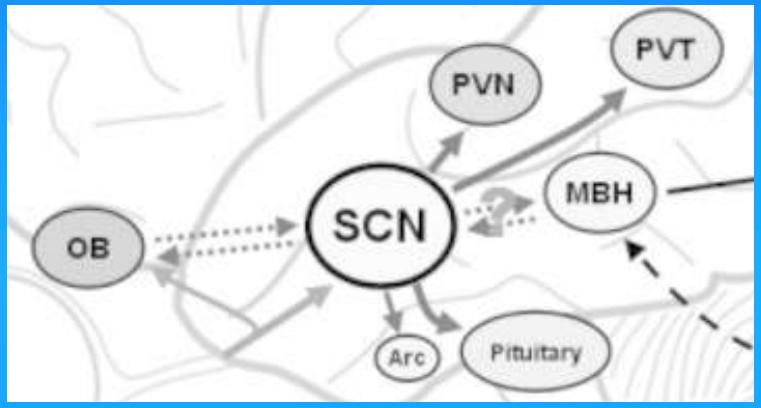
Sleep & Awake rhythms

regulate all metabolic processes

regulate all neurological processes

SMELL

OB – Olfactory Bulb drives the SCN (primary clock)



Hunger & Satiety rhythms → Sleep & Awake rhythms

regulate all metabolic processes

regulate all neurological processes

SMELL

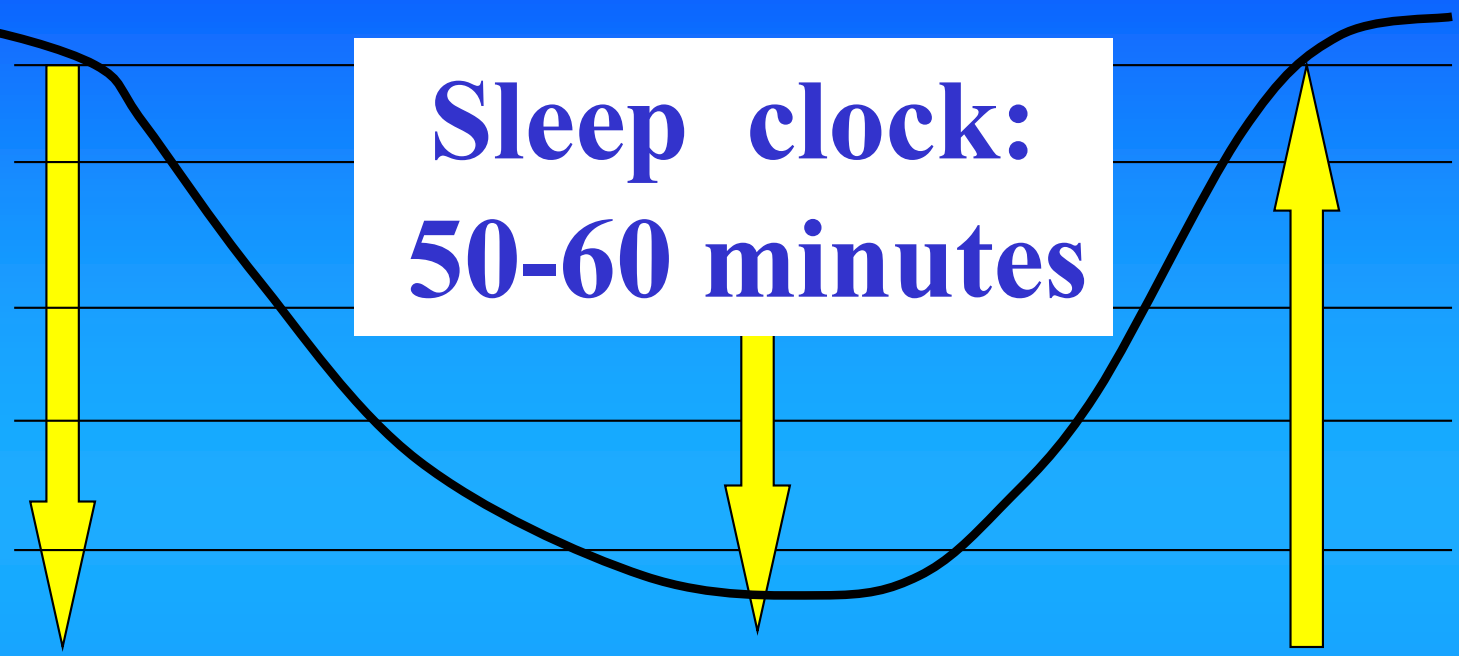
<u>modulates state organisation</u>
elicits emotional behaviours

activates pre-feeding actions
anticipatory digestive physiology
regulates pace of ingestive behaviour

Schaal 2004

BRAIN WIRING

REM
NR1
NR2
NR3
SWS



ACQUISITION

poly-sensory input
short-term memory
stored cortex

Awake and REM

CONSOLIDATION

transfer information
"SNR" strong signals
amygdala /
hippocampus
NREM stage 4

MEMORY FORMATION

P waves
returns info
to neocortex:
organized
REM

The Neuroscience of Birth & Breastfeeding

The DNA → The Brain → Behaviour

EPIGENETICS NEURODEVELOPMENT EVOLUTIONARY BIOLOGY

ENVIRONMENT ADAPTATION → EXPERIENCE → REPRODUCTIVE FITNESS

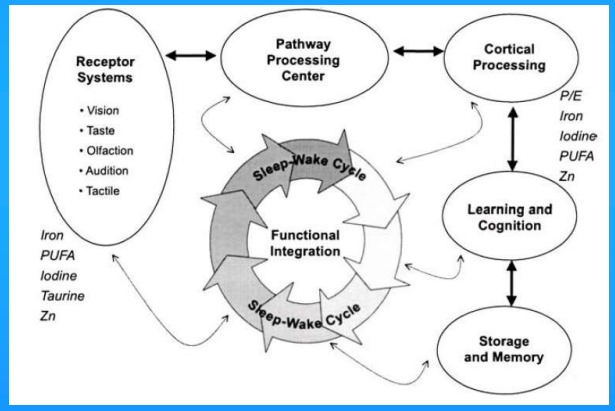
BABY

BIRTH — BONDING

BEYOND — BREASTFEEDING

Feed → Sleep Cycling

Secure attachment



Feed interval is one sleep cycle

Early Human Development, 25 (1991) 197—208
Elsevier Scientific Publishers Ireland Ltd.

EHD 01145

The emergence of adrenocortical circadian function in newborns and infants and its relationship to sleep, feeding and maternal adrenocortical activity

Gottfried Spangler

Sleeping, feeding and maternal-infant interaction rhythms are established much earlier.

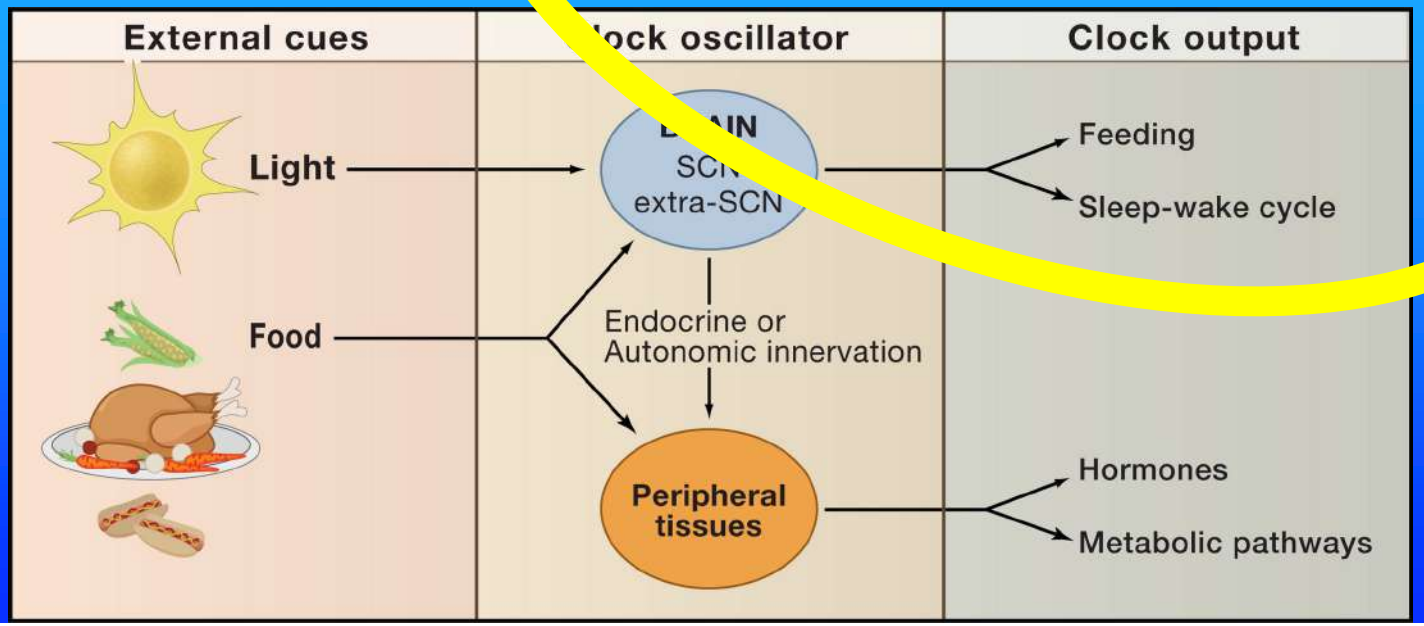
http://www.cell.com/fulltext/S0092-8674(08)01067-2

External Cues and Clock Outputs

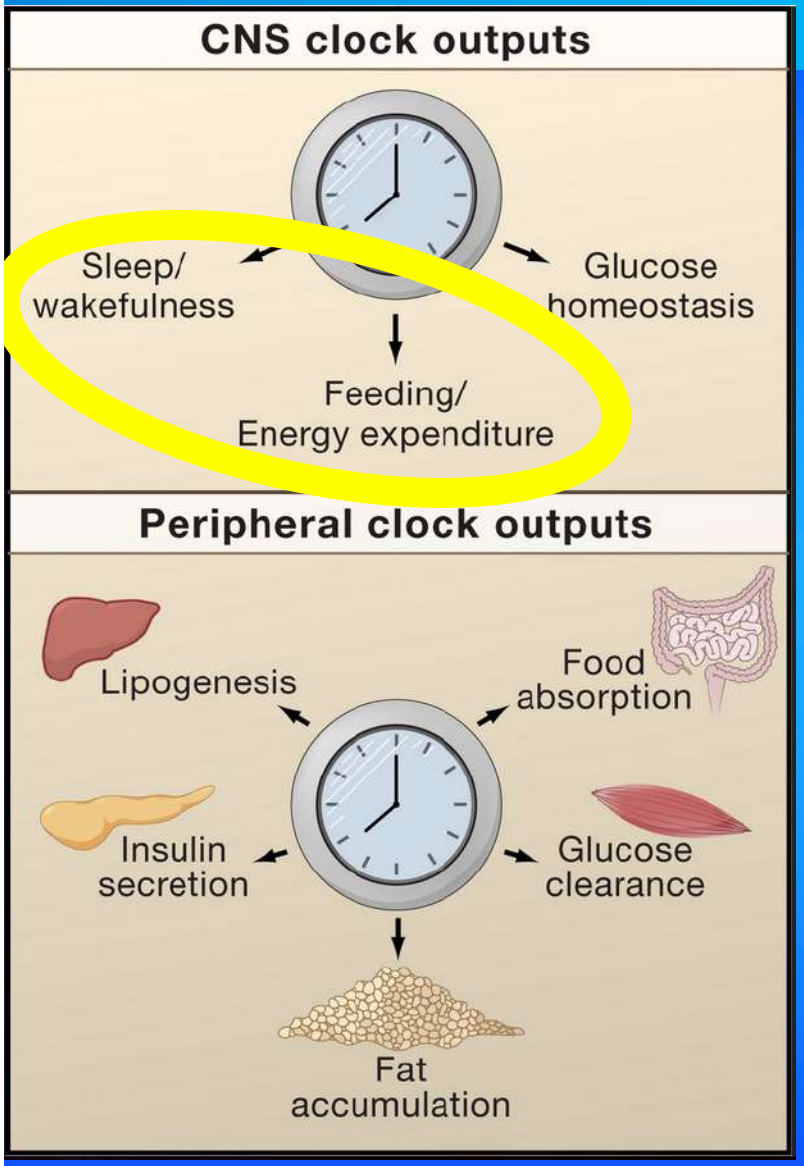
The predominant external cue (zeitgeber) of the SCN clock is light.

Clocks in peripheral tissues such as the liver also can be entrained by food.

Outputs of both the SCN and peripheral clocks impact behavioral and metabolic responses such as feeding, sleep-wakefulness …



Central Pacemaker and Peripheral Clocks



The master pacemaker encoding the mammalian clock resides within the SCN, although clock genes are also expressed in other regions of the brain and in most peripheral tissues. Emerging evidence suggests that peripheral tissue clocks are synchronized through humoral, nutrient, and autonomic wiring and that the cell-autonomous function of the clock is important in pathways involved in fuel storage and consumption.

clocks are synchronized

Joseph 2014

Arch Dis Child Fetal Neonatal Ed. 2014 Sep 22. pii: fetalneonatal-2014-306104.
doi: 10.1136/archdischild-2014-306104. [Epub ahead of print]

Getting rhythm: how do babies do it?

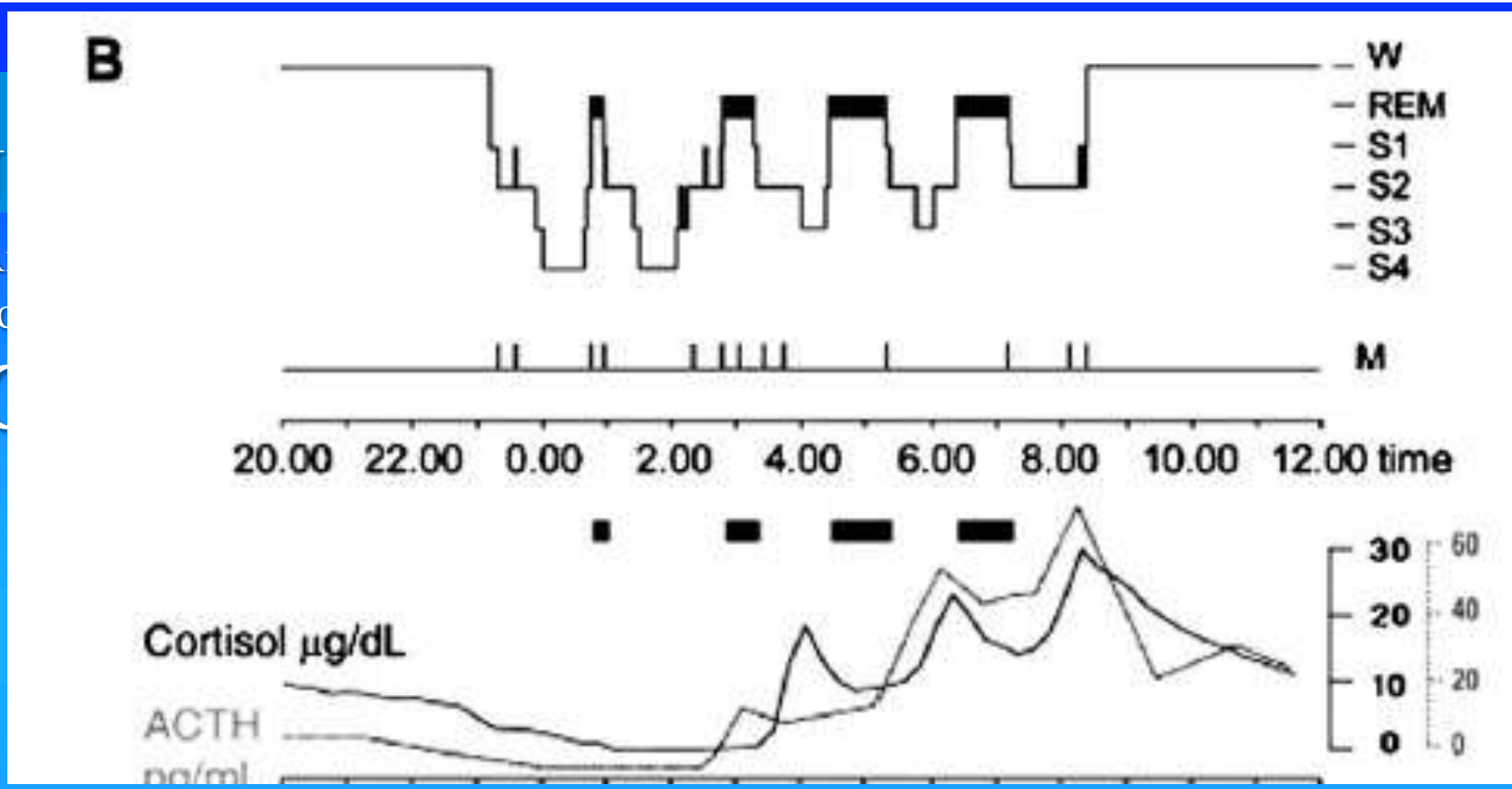
dates averaged → "between 6 and 18 weeks"

J

A

d

C



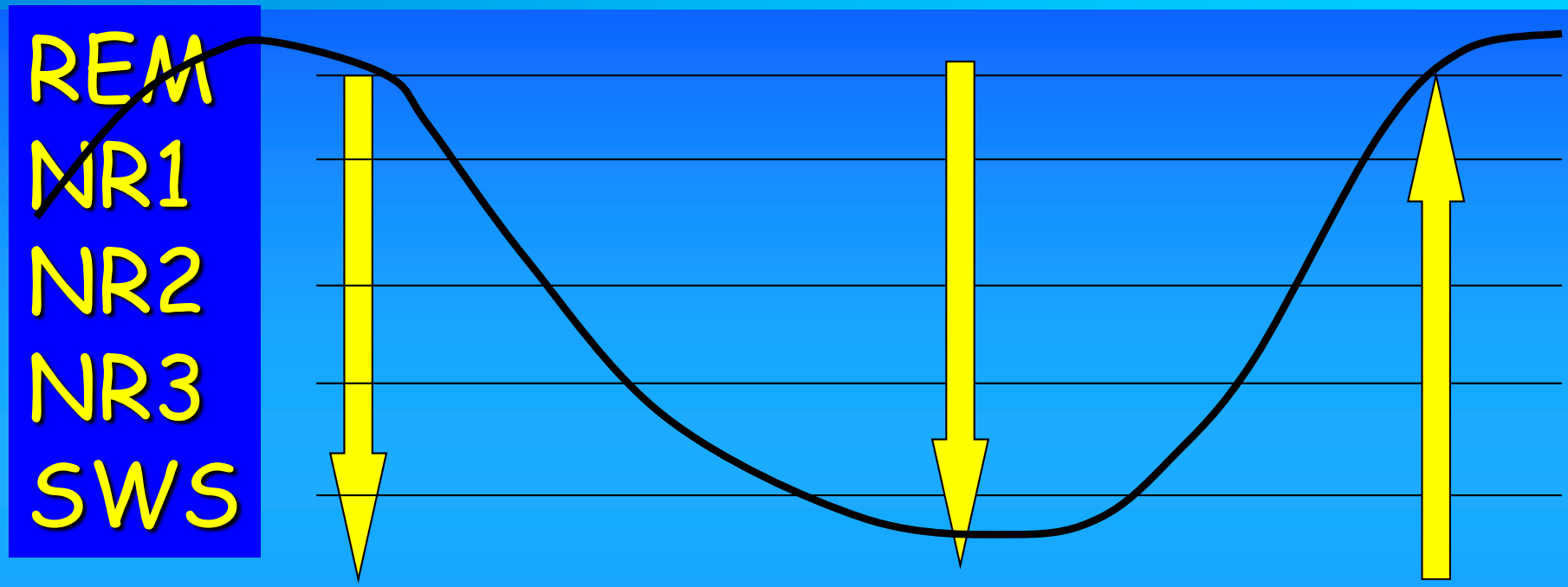
CORTISOL
day-night
rhythm

TEMPERATURE
day-night
rhythm

Birth ~ /~ 8w 9w 10w 11w

dates averaged → "between 6 and 18 weeks"

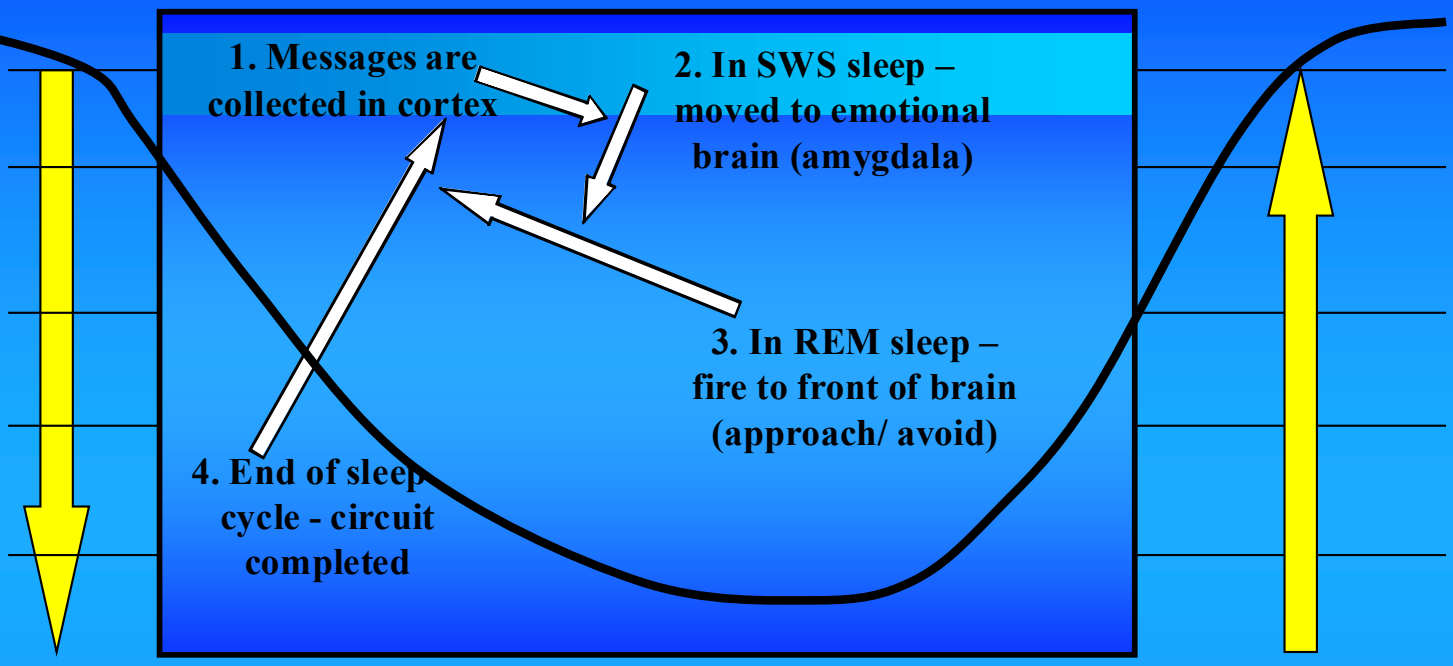
BRAIN WIRING



SLEEP CYCLE IS ONE HOUR

BRAIN WIRING

REM
NR1
NR2
NR3
SWS



ACQUISITION	CONSOLIDATION	MEMORY FORMATION
poly-sensory input short-term memory stored cortex	transfer information "SNR" strong signals amygdala / hippocampus	P waves returns info to neocortex: organized
Awake and REM	NREM stage 4	REM

BRAIN WIRING

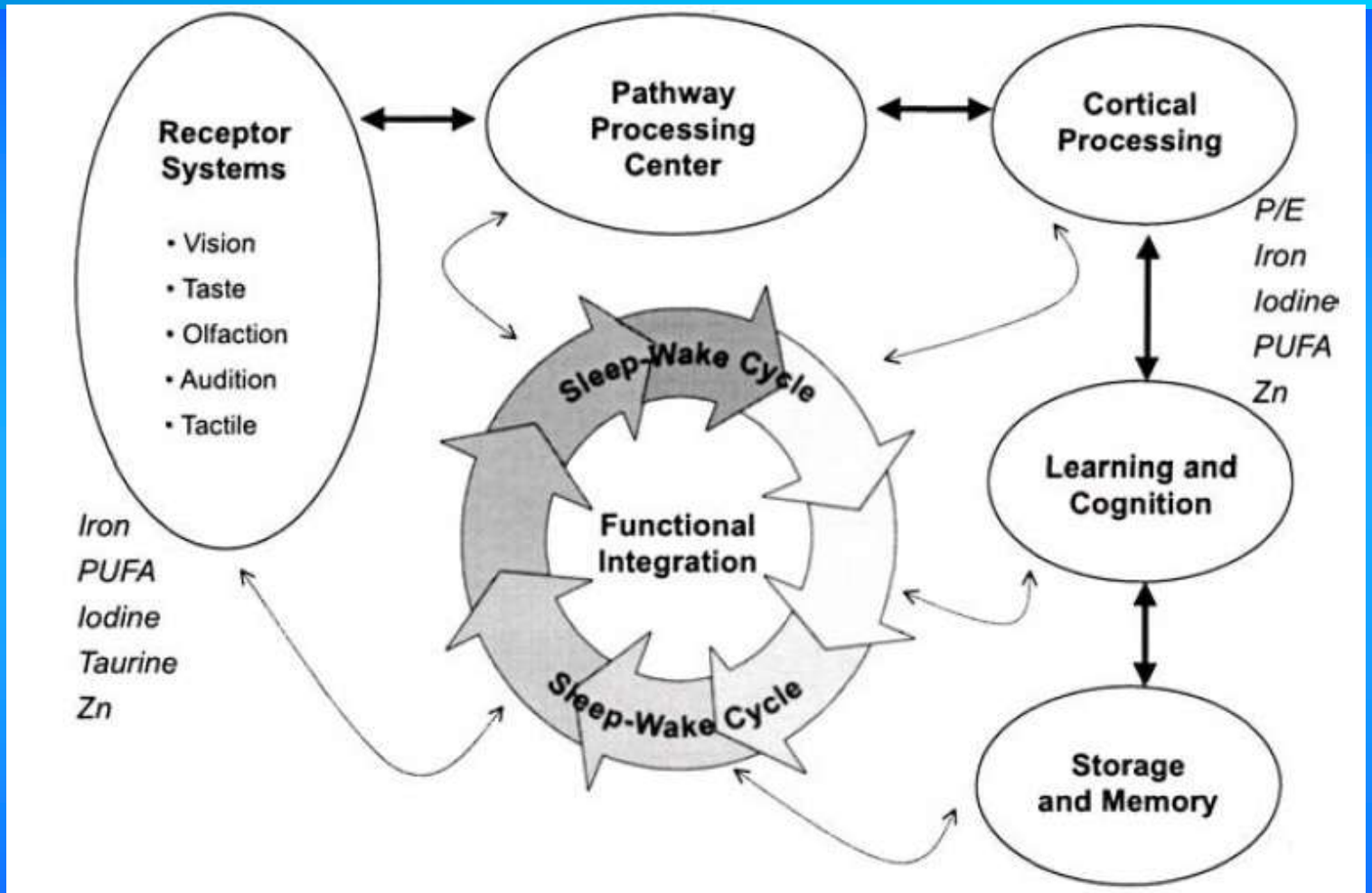


Fig 4. Schematic representation of the interaction between sensory receptors and CNS functions within the framework of the sleep-wake cycle. Nutrients with proven effects on sensory receptors and/or cortical processing are included (*PUFA*, polyunsaturated fatty acids; *Zn*, zinc; *P/E*, protein/energy).

Peirano 2003

Early Human Development, 25 (1991) 197—208
Elsevier Scientific Publishers Ireland Ltd.

EHD 01145

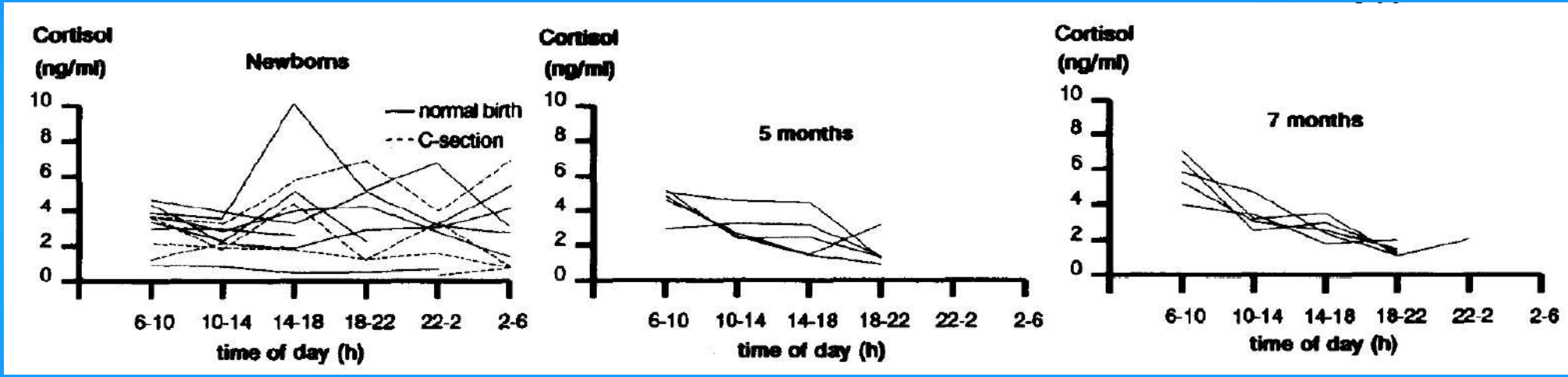
The emergence of adrenocortical circadian function in newborns and infants and its relationship to sleep, feeding and maternal adrenocortical activity

Gottfried Spangler

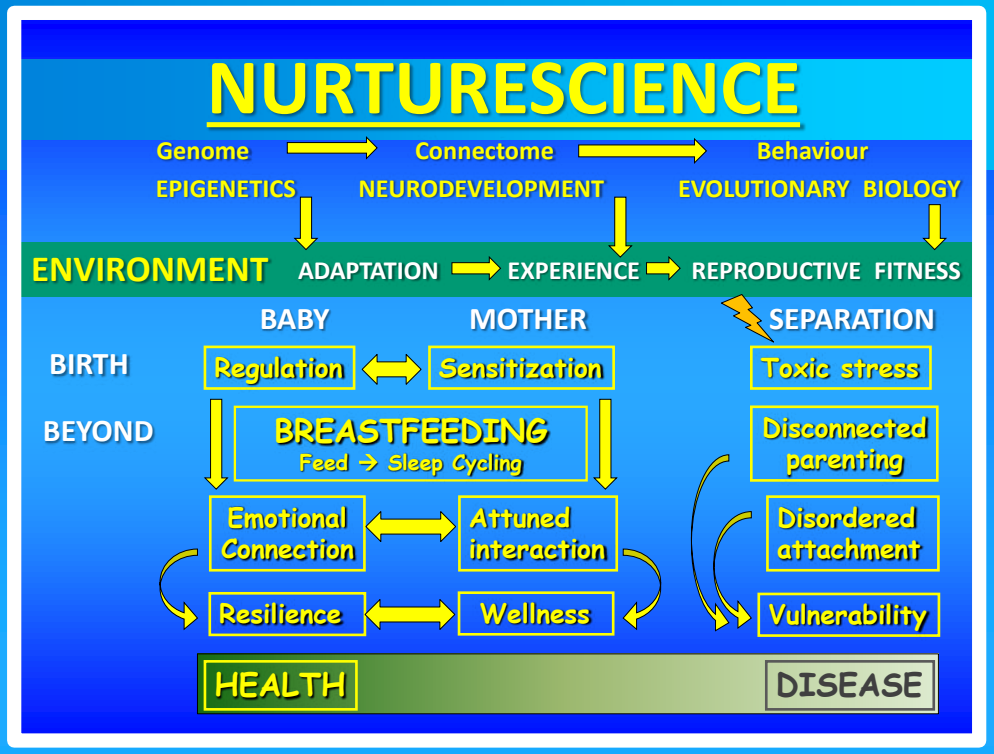
Sleeping, feeding and maternal-infant interaction rhythms are established much earlier.

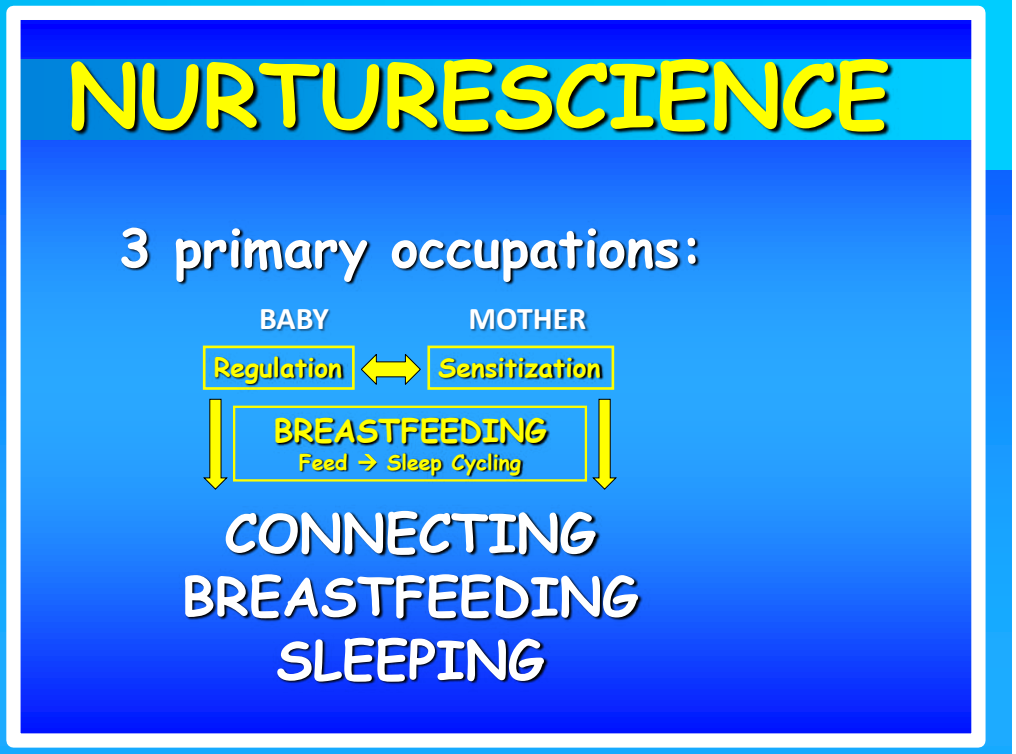
CIRCADIAN CORTISOL

Newborn	5 months	7 months
none	some	most



Sleeping, feeding and maternal-infant interaction rhythms are established much earlier.

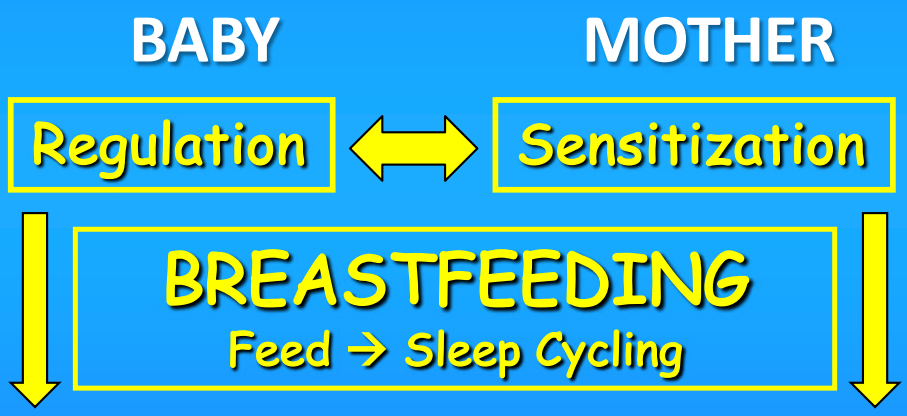




Sleeping, feeding and maternal-infant interaction rhythms are established much earlier.

NURTURESCIENCE

3 primary occupations:



CONNECTING
BREASTFEEDING
SLEEPING

Pleasurable feeding

- and sleeping -

a physiological rhythm for premature infants.

one hour sleep-wake cycles

feed cycles

What evidence ?

Karen Edmond, MBBS, MSc (Epidemiology), PhD
London School of Hygiene and Tropical Medicine, London, U.K.

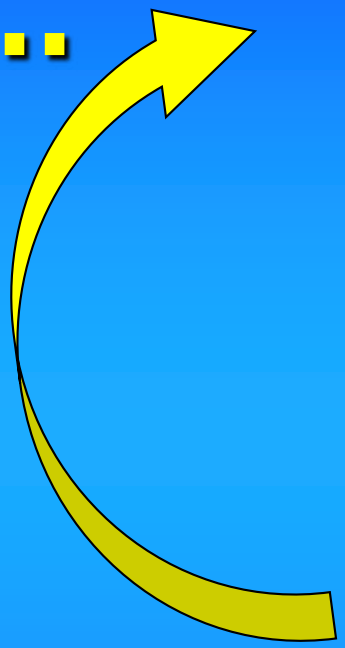
Rajiv Bahl, MD, PhD
Department of Child and Ad... and Development, WHO, G...

EVIDENCE FOR FEEDING FREQUENCY ????

Edmond 2006

No RCT's ...

Because no one did the study.



No RCT's ...

Insufficient evidence

Conclusions and implications

Only case series and descriptive studies were located in this section. These describe the

about the safest or most effective regimens. No implications can be drawn for infants of particular gestational ages or birth weights.

NEVERTHELESS:

No RCT's ...

Because no one did the study.

SOME FACTS →

No RCT's ...

Insufficient evidence

Conclusions and implications

Only case series and descriptive studies were located in this section. These describe the

about the safest or most effective regimens. No implications can be drawn for infants of particular gestational ages or birth weights.

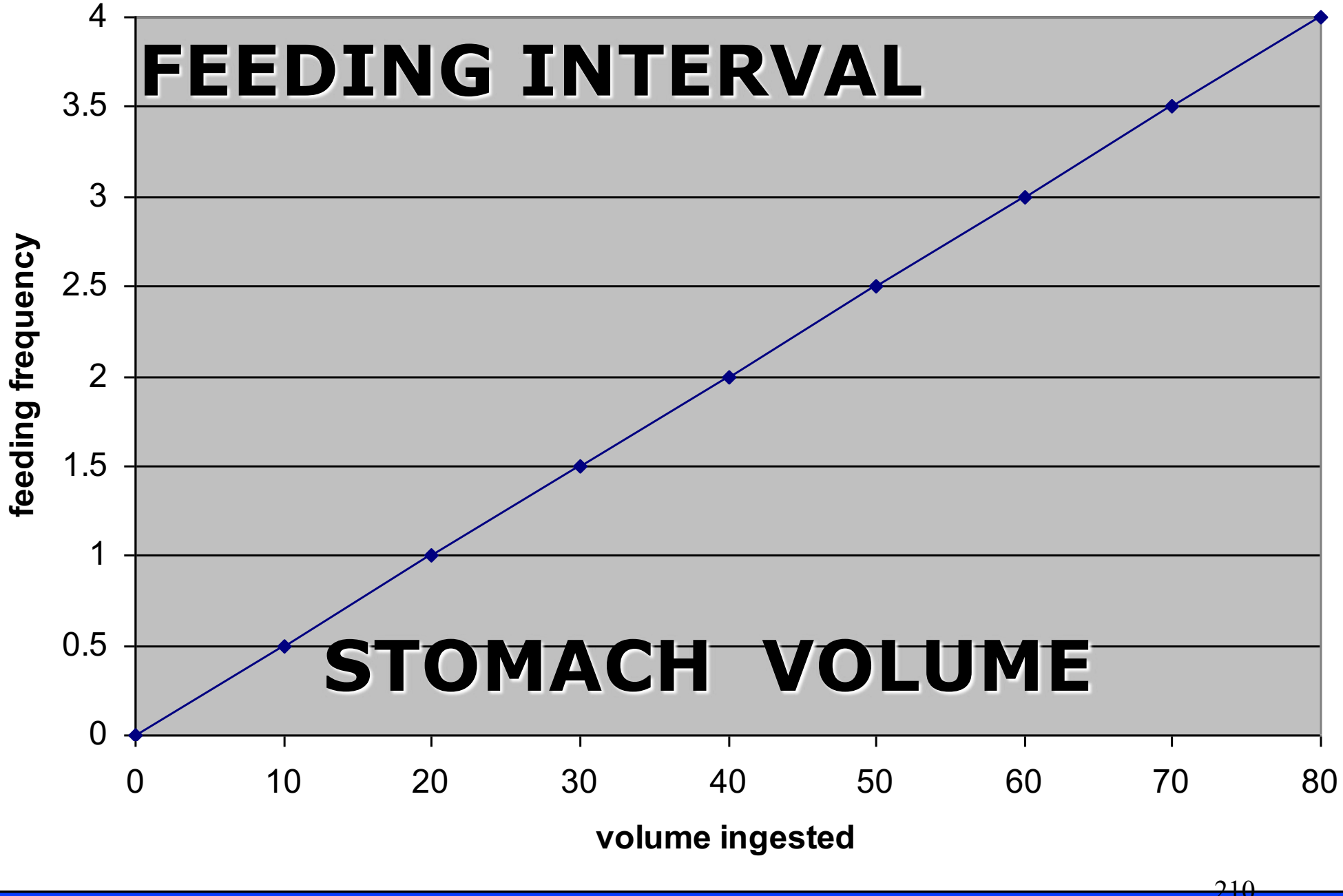
NEVERTHELESS:

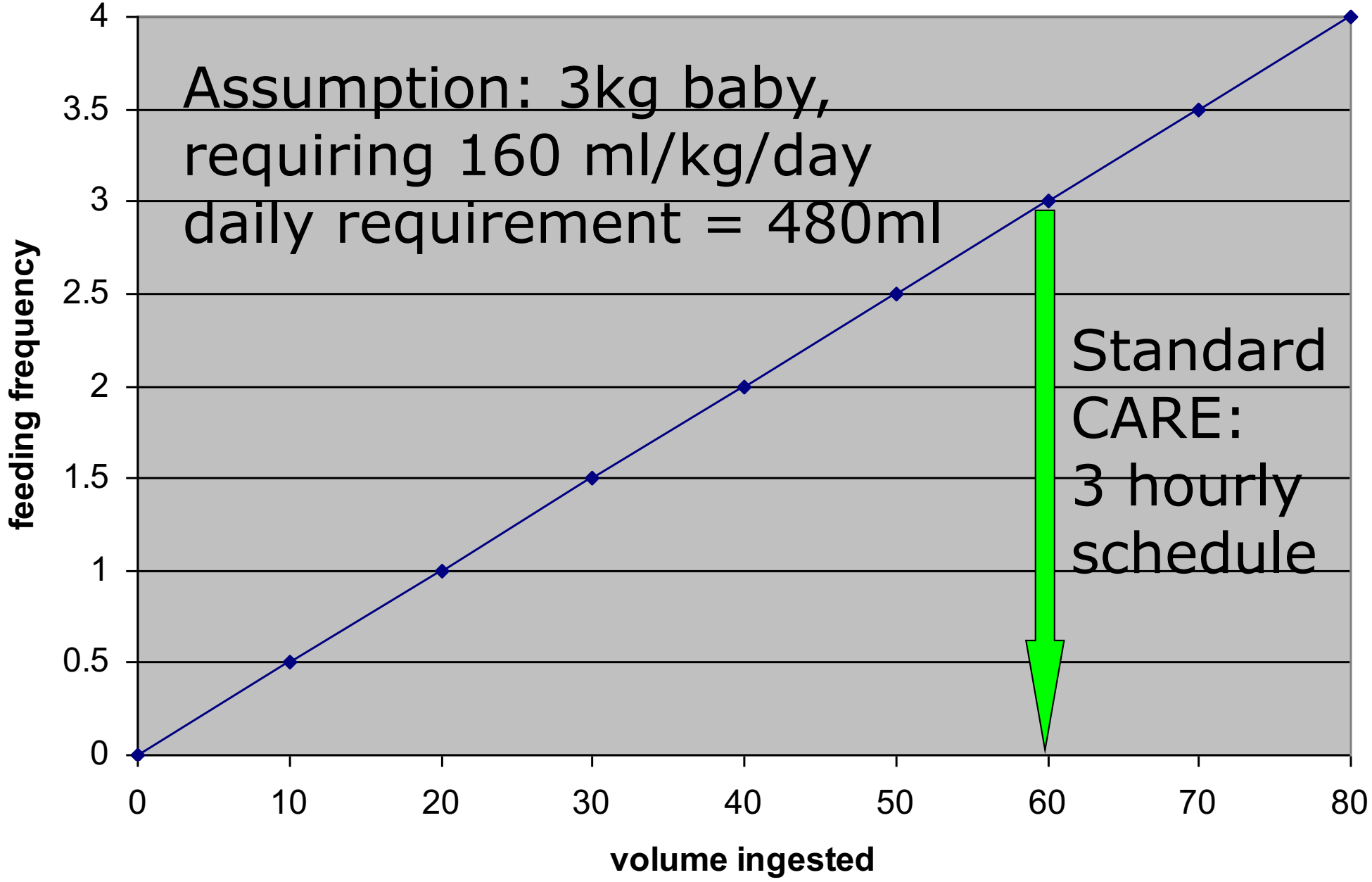
FEEDING FREQUENCY

SOME FACTS →

$\frac{1}{\text{FEEDING INTERVAL}}$.

STOMACH VOLUME


FEEDING INTERVAL
STOMACH VOLUME
feeding frequency
volume ingested
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50
60
70
80


Assumption: 3kg baby,
requiring 160 ml/kg/day
daily requirement = 480ml
Standard
CARE:
3 hourly
schedule
feeding frequency
volume ingested
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50
60
70
80

KEY QUESTION:

WHAT IS THE STOMACH VOLUME OF THE NEONATE ???

EVIDENCE: (NBn 111009)

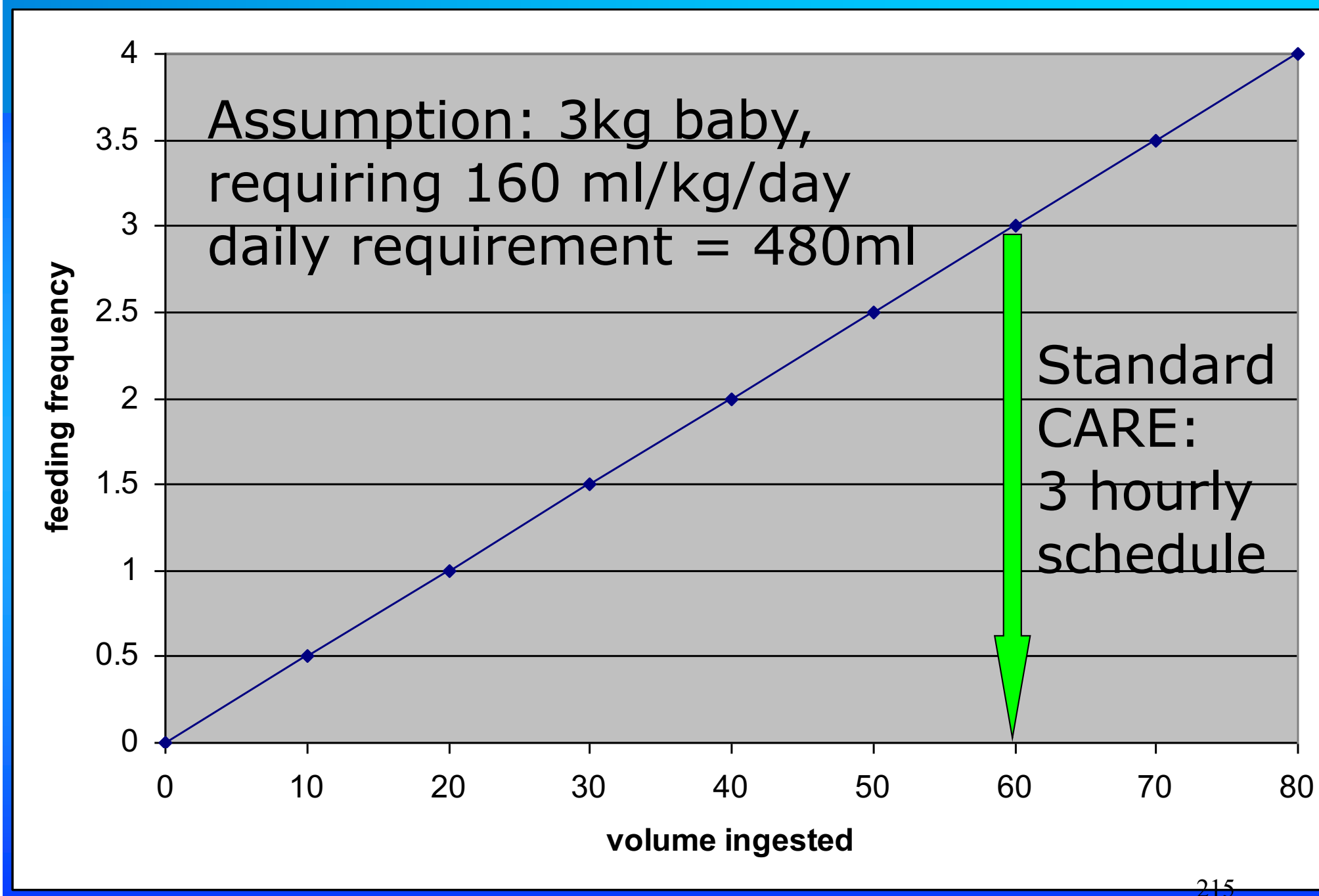
Author	Capacity	Note:
Sase	10-15 ml	Live, term fetus
Goldstein	10-15 ml	Live, term fetus
Widstrom	10 mls	Live, newborn
Zangen	20 mls	Live, (pressure)
Naveed	20 mls	Autopsy (SB)
	20 mls	Autopsy (ENND)
Kernessuk	15 mls	Autopsy (in situ)
Scammon (Alliot)	30-35 ml	Autopsy (water pressure)

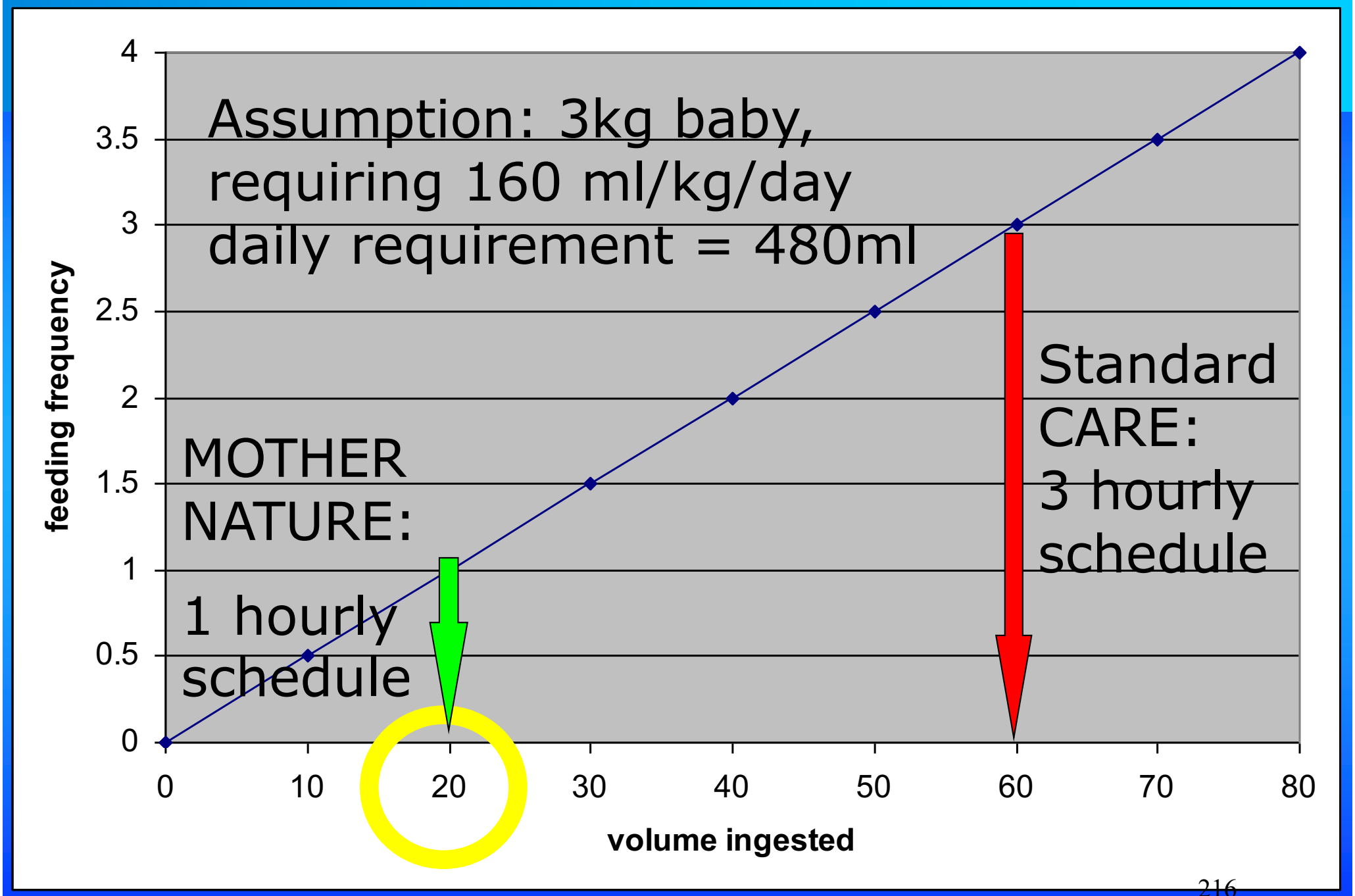
PROPOSAL:

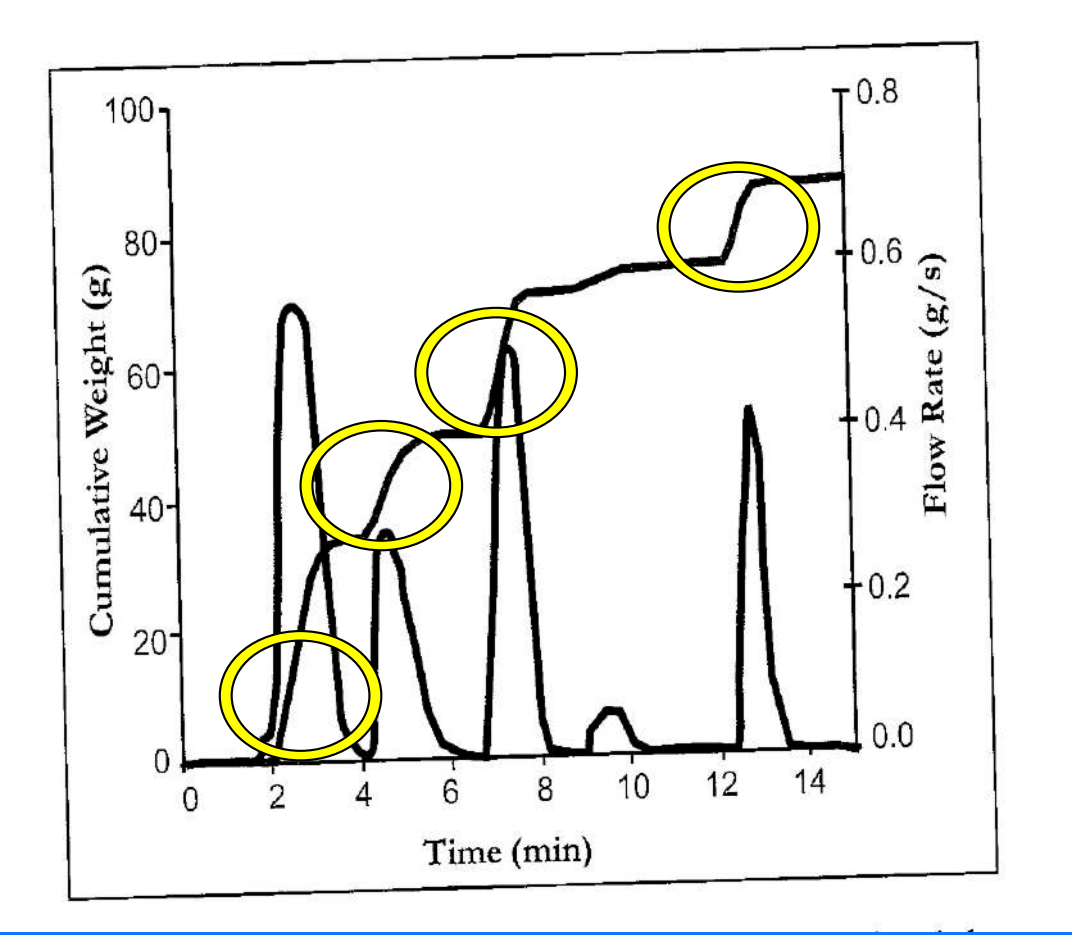
The CAPACITY of a neonate's stomach is

approx 20 ml.

(7ml /kg)


Assumption: 3kg baby,
requiring 160 ml/kg/day
daily requirement = 480ml
Standard
CARE:
3 hourly
schedule
feeding frequency
volume ingested
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50
60
70
80


Assumption: 3kg baby,
requiring 160 ml/kg/day
daily requirement = 480ml
MOTHER
NATURE:
1 hourly
schedule
Standard
CARE:
3 hourly
schedule
feeding frequency
volume ingested
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50
60
70
80

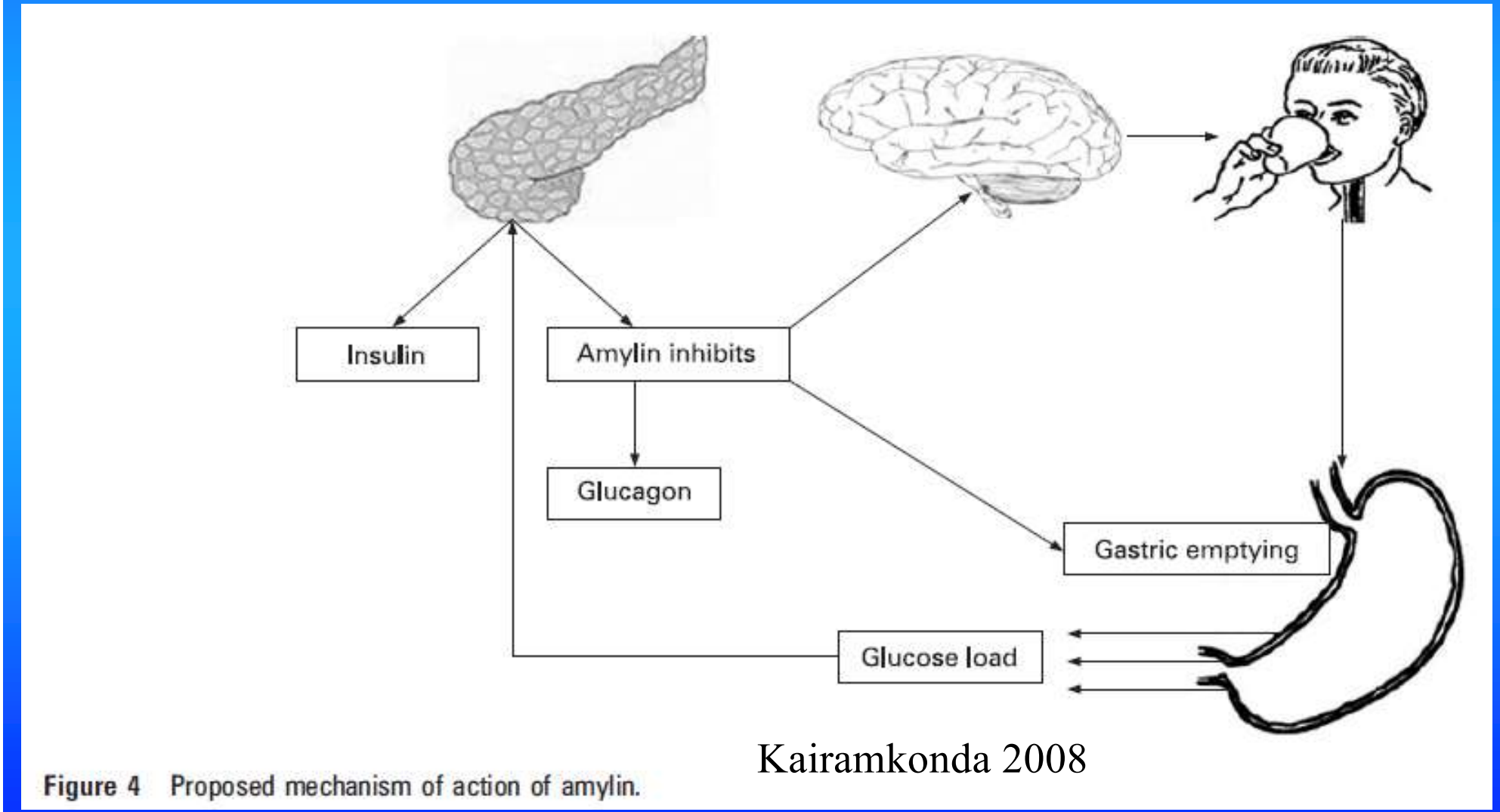


A single MER (milk ejection reflex)
is 20 ml

Regardless of breast size, mammary gland tissue fairly constant

Prime 2007

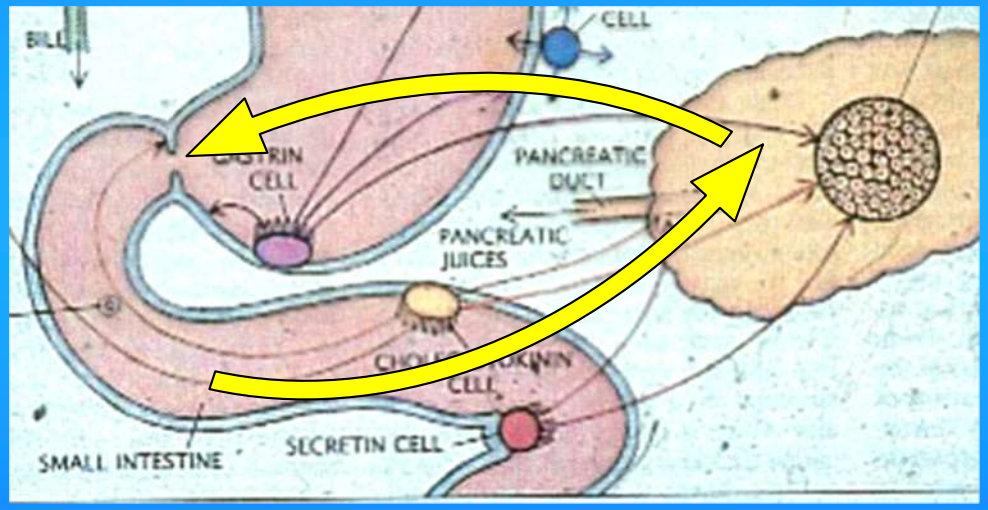
AMYLIN peptide



Kairamkonda 2008

Figure 4 Proposed mechanism of action of amylin.

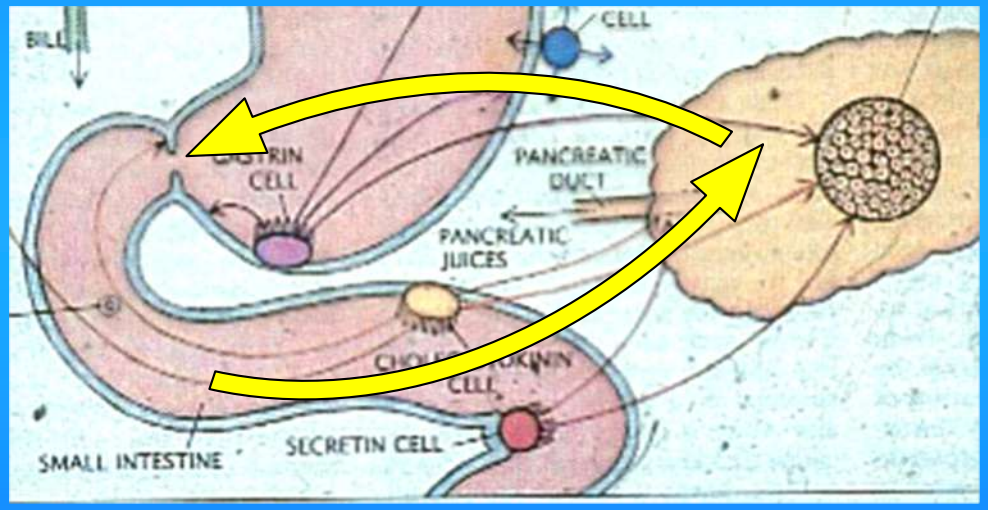
AMYLIN released



Food in duodenum

Closes pylorus

AMYLIN released



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Closes pylorus

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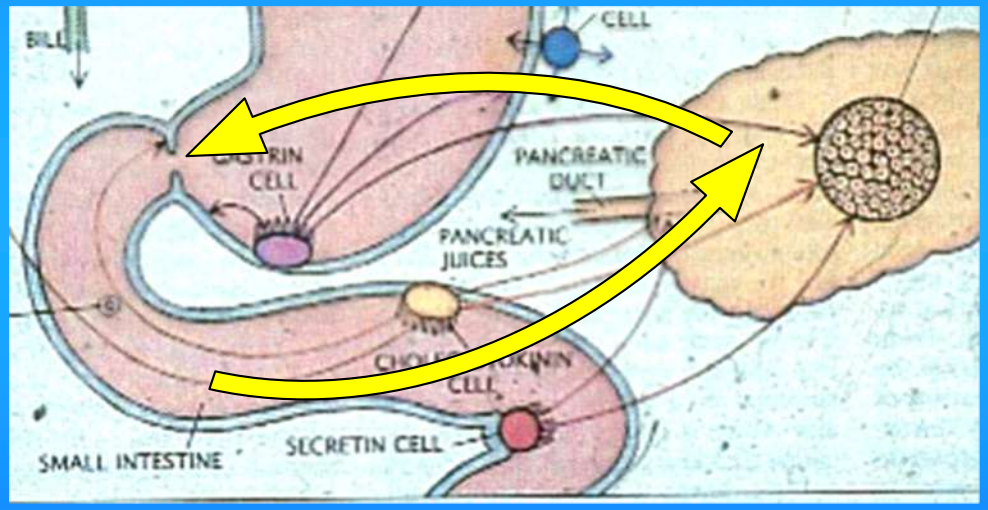


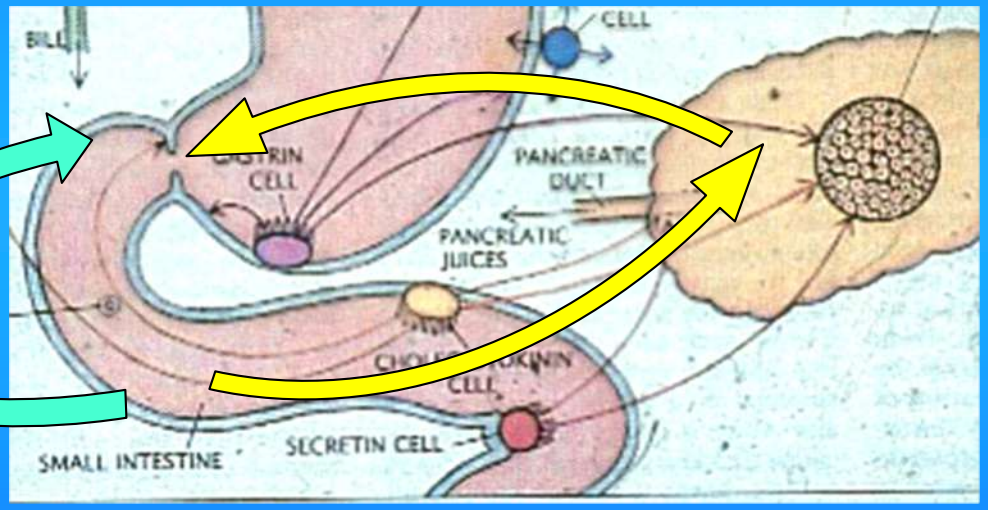
Duodenum empty

Food in duodenum

Closes pylorus

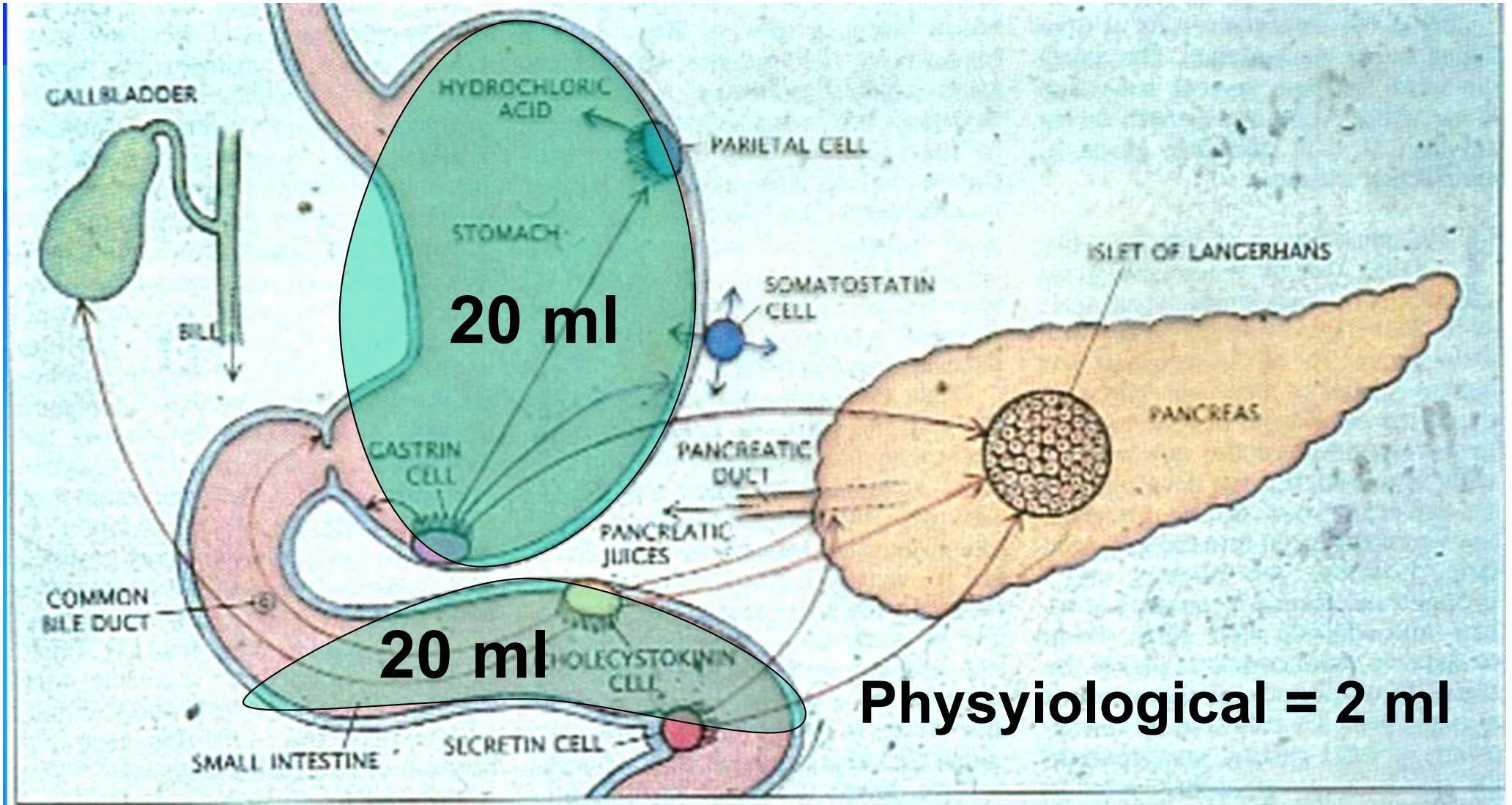
AMYLIN released

Pylorus opens



Duodenum empty

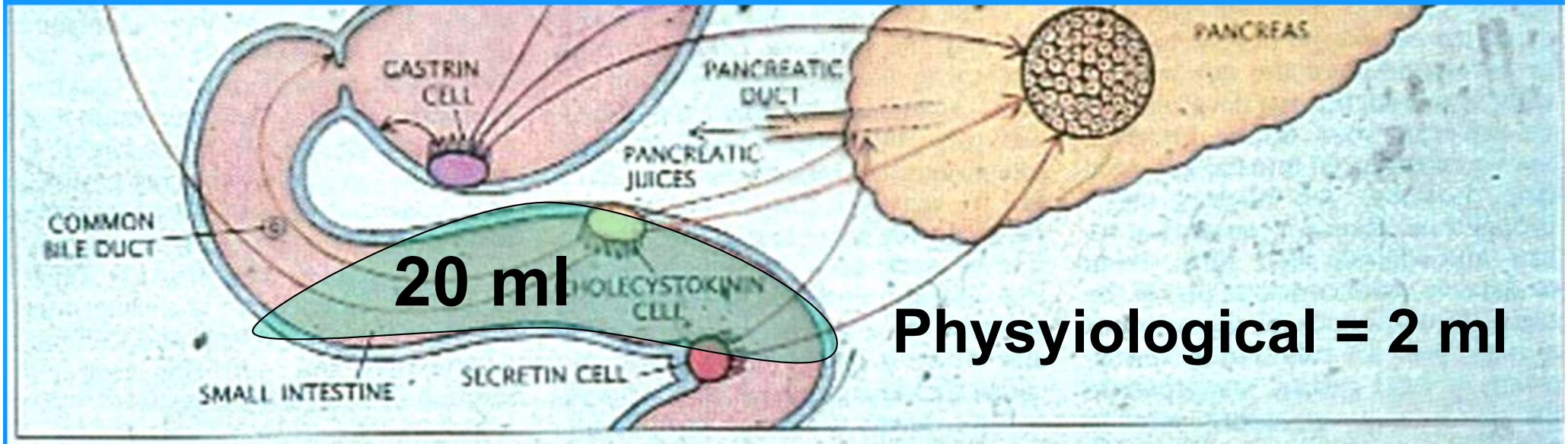
Food in duodenum



GASTROINTESTINAL HORMONES are secreted into the gut and the circulation by endocrine cells in the wall of the stomach and small intestine. Gastrin, cholecystokinin and secretin enhance pancreatic insulin secretion. Gastrin also stimulates release of hydrochloric acid, growth of mucosal cells and gastric motility. Cholecystokinin slows emptying of the stomach and stimulates discharge of bile from the gallbladder and secretion of digestive enzymes by the pancreas; secretin stimulates pancreatic bicarbonate secretion. Somatostatin inhibits secretion of gut hormones and counteracts their effects.

Amylin peptide is increased in preterm neonates with feed intolerance

V R Kairamkonda,[1] A Deorukhkar,[2] C Bruce,[3] R Coombs,[2] R Fraser,[3] A-P T Mayer[4]



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Kerstin Uvnäs-Moberg

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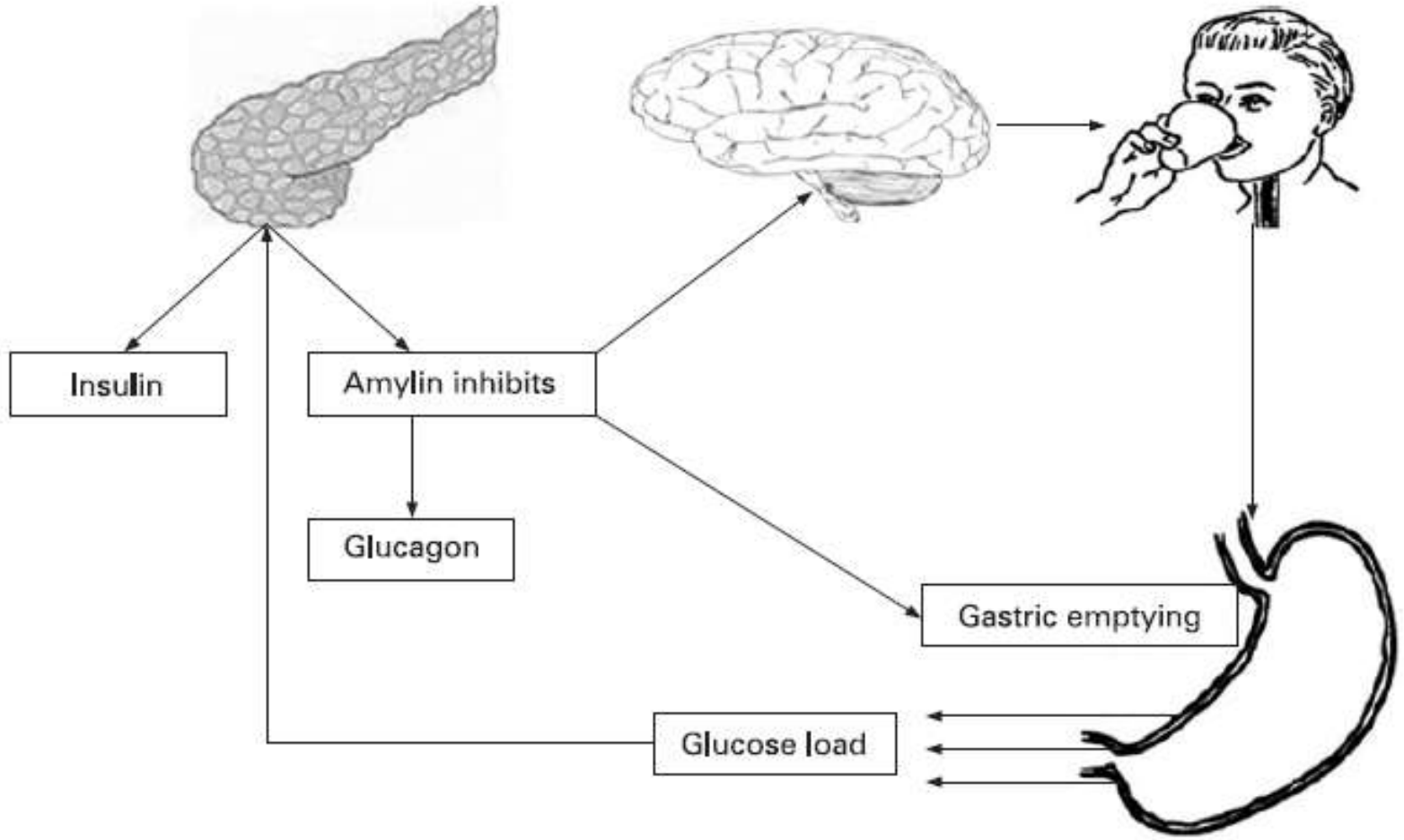

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"Feed intolerance" ...

... or VOLUME intolerance?

2 - 3 hourly feeds are

not physiological ...

... not pleasurable

CONTINUOUS FEEDING PROMOTES GASTROINTESTINAL TOLERANCE AND GROWTH IN VERY LOW BIRTH WEIGHT INFANTS

ANN DSILNA, RN, BASC, KYLLIKE CHRISTENSSON, RNM, PHD, LARS ALFREDSSON, PHD, HUGO LAGERCRANTZ, MD, PHD, AND MATS BLENNOW, MD, PHD

In VLBW infants, continuous feeding seems to be better than intermittent feeding with regard to gastrointestinal tolerance and growth.

(J Pediatr 2005;147:43-9)

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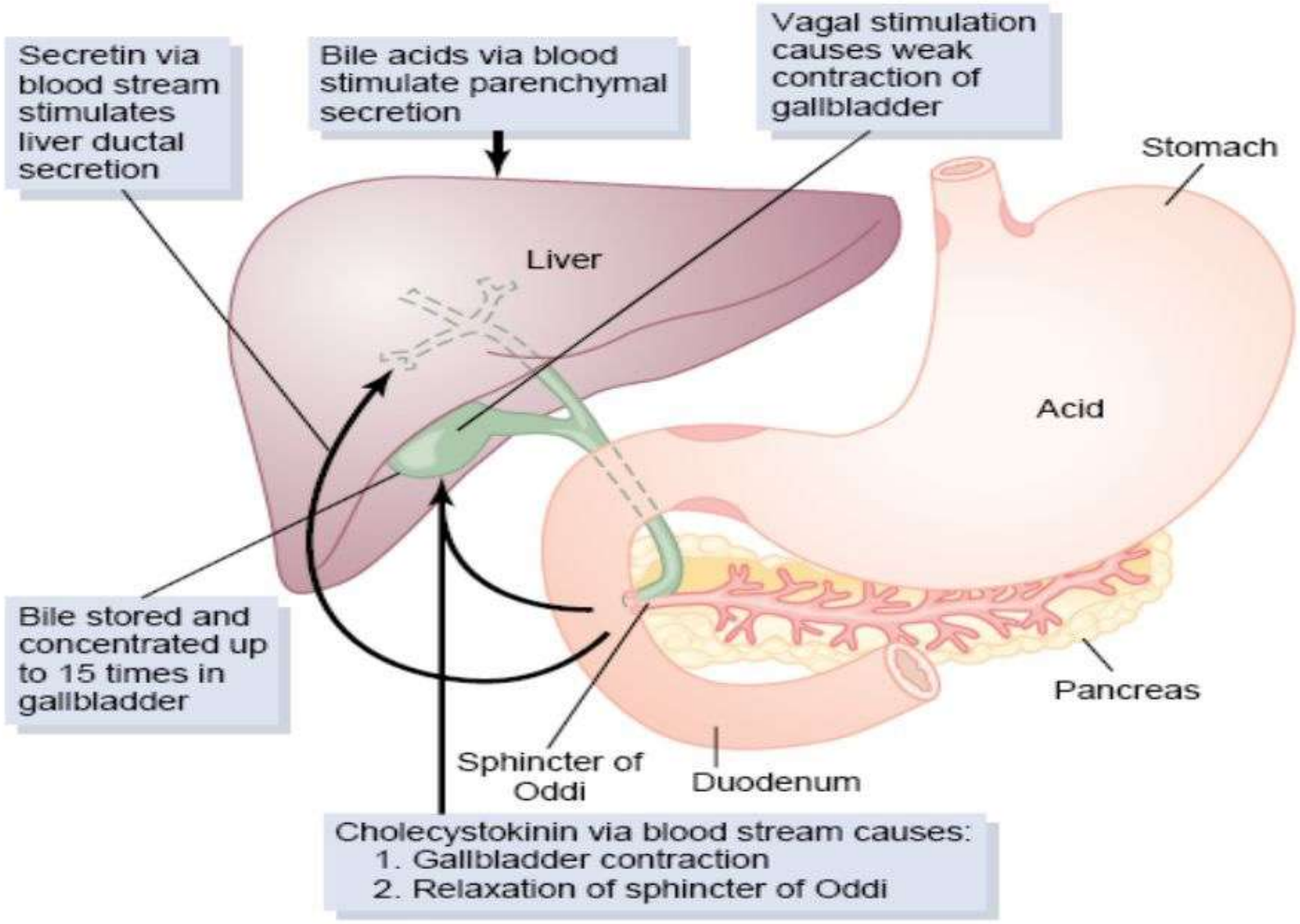
no rhythmicity …

how physiological is this ???

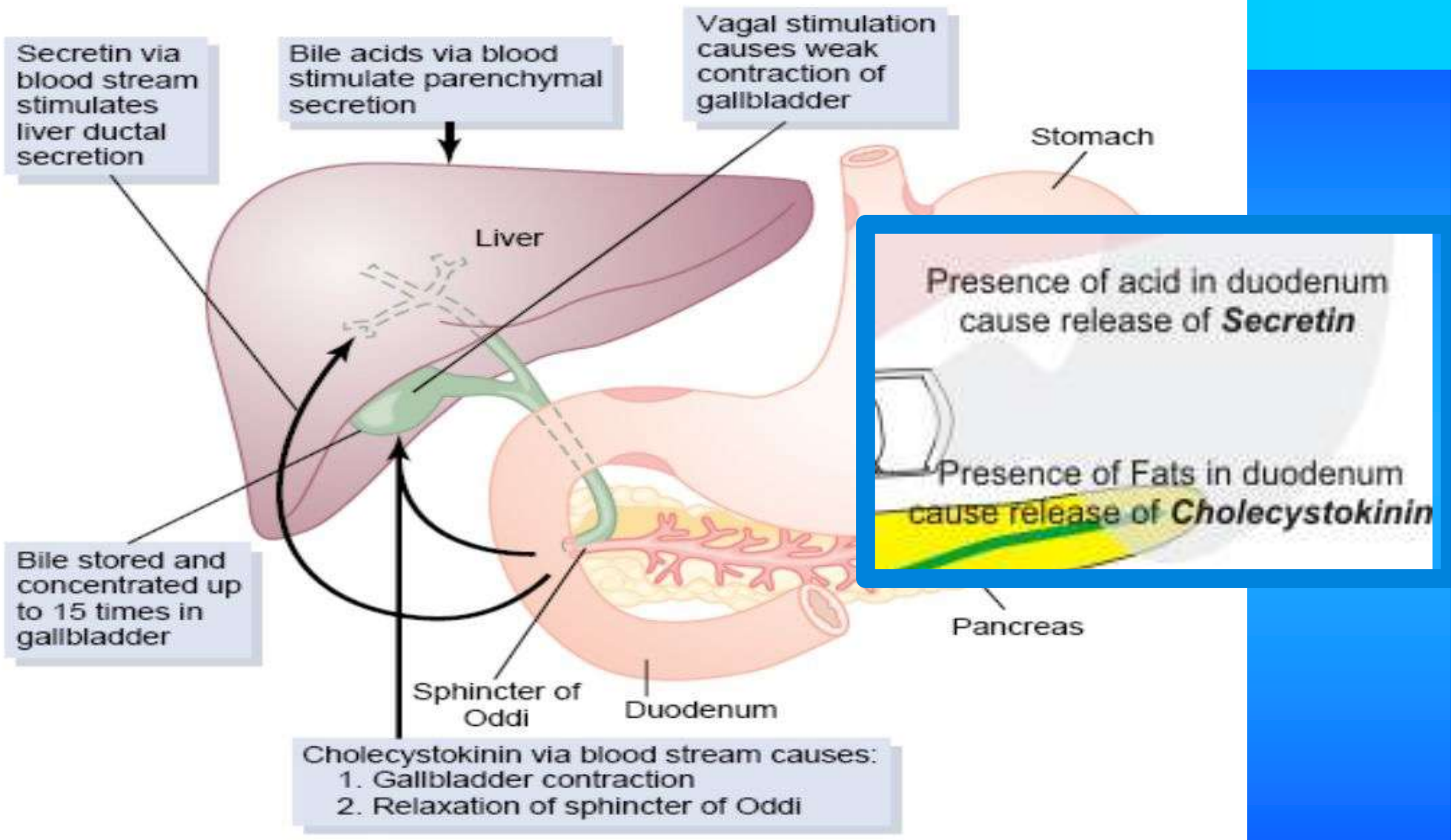
Liver secretion and gallbladder emptying.



how physiological is this ???

http://slideplayer.com/slide/11085201/

Liver secretion and gallbladder emptying.



how physiological is this ???

http://slideplayer.com/slide/11085201/

Continuous enteral feeding impairs gallbladder emptying in infants

Girish Jawaheer, FRCS, Nigel J. Shaw, MD, MRCP, and Agostino Pierro, MD, FRCS

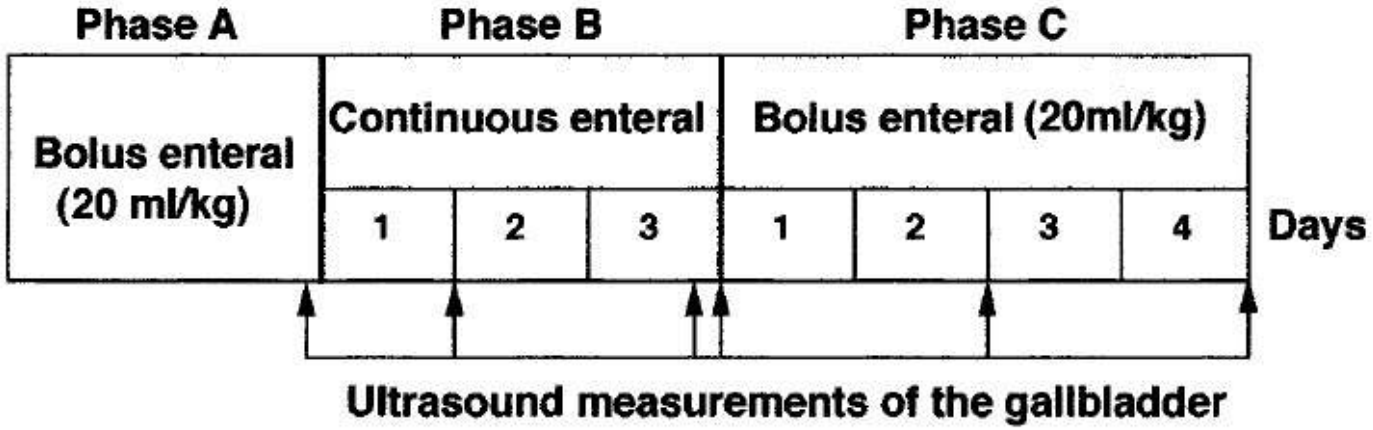


Fig 1. Study design. In phase A, infants received bolus enteral feeds. In phase B, bolus feeds were stopped and replaced with continuous enteral feeds for 3 days. In phase C, bolus enteral feeds were resumed. Ultrasound measurements of gallbladder were made at time of last bolus feed in phase A, after 1 and 3 days of phase B, after first resumed bolus feed, and after 2 and 4 days of phase C.

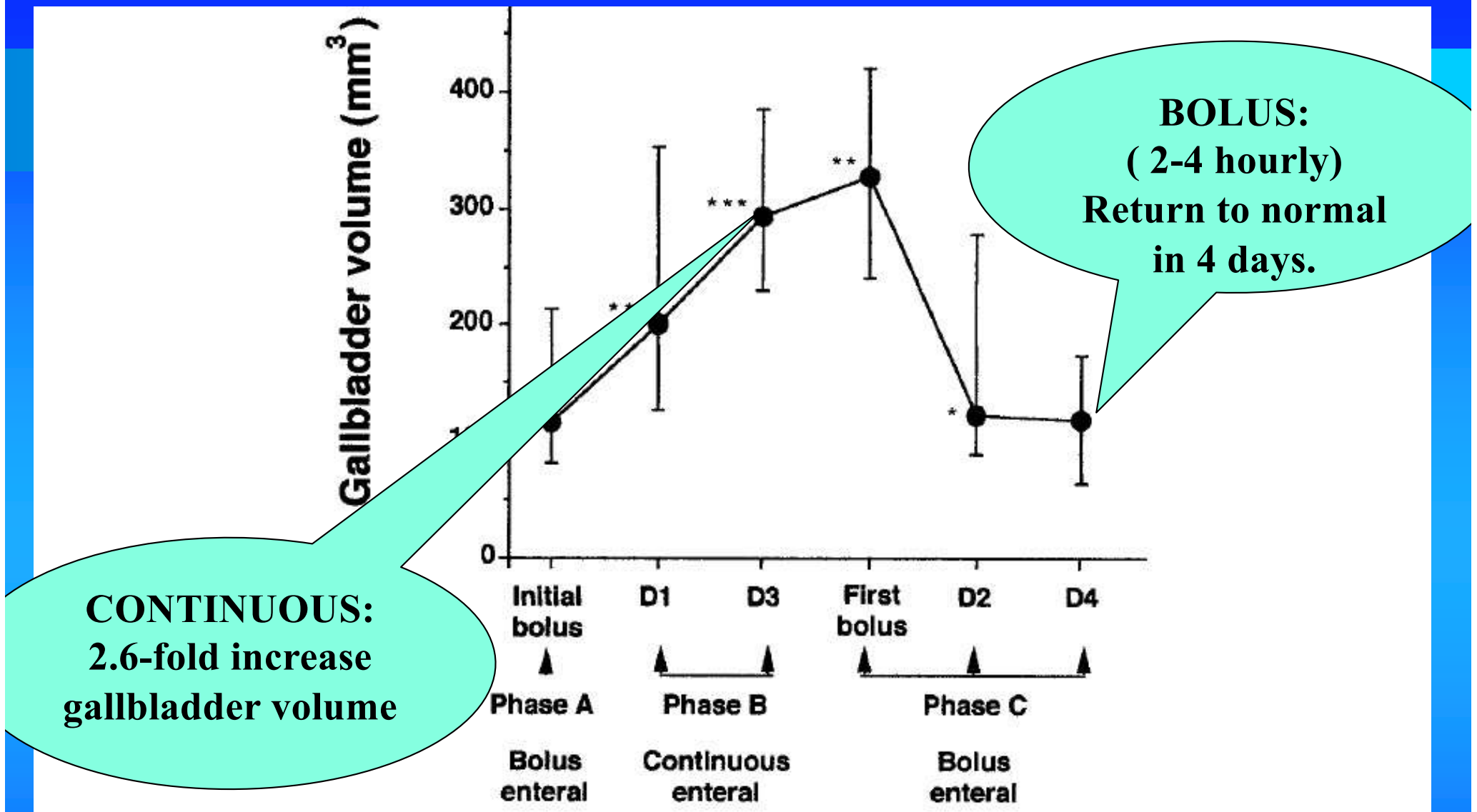


Fig 2. Effect of continuous enteral feeding on gallbladder volume. Continuous enteral feeding in phase B causes 2.6-fold increase in gallbladder volume, compared with phase A. Resumption of bolus feeds in phase C causes gallbladder volume to return to normal within 4 days. Results are expressed as median. Error bars indicate interquartile range. Prefix D indicates experimental day. (***$P < .001$; *$P < .01$; *$P < .05$ compared with phase A).

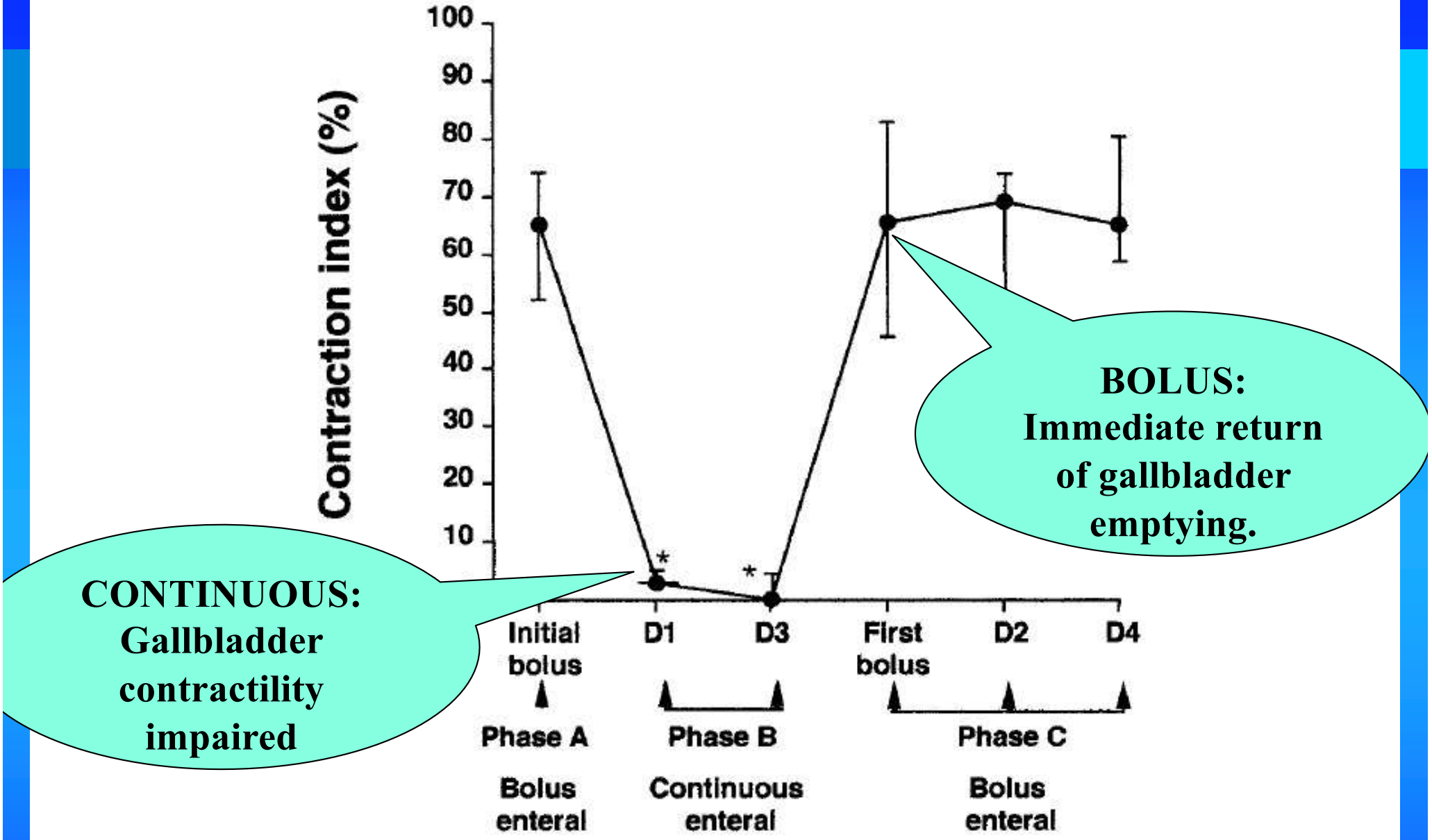


Fig 3. Effect of continuous enteral feeding on contraction index. Gallbladder contractility is impaired during continuous enteral feeding in phase B. Resumption of bolus feeds in phase C causes immediate return of normal gallbladder emptying. Results are expressed as median. Prefix D indicates experimental day. (*$P < .001$ compared with phase A).

Continuous enteral feeding impairs gallbladder emptying in infants

Girish Jawaheer, FRCS, Nigel J. Shaw, MD, MRCP, and Agostino Pierro, MD, FRCS

… it can be inferred that the continuous feeding modality, enteral or parenteral, may play a role in inducing stasis in the extrahepatic biliary tree.

"Ontogeny of gastric emptying patterns in the human fetus"

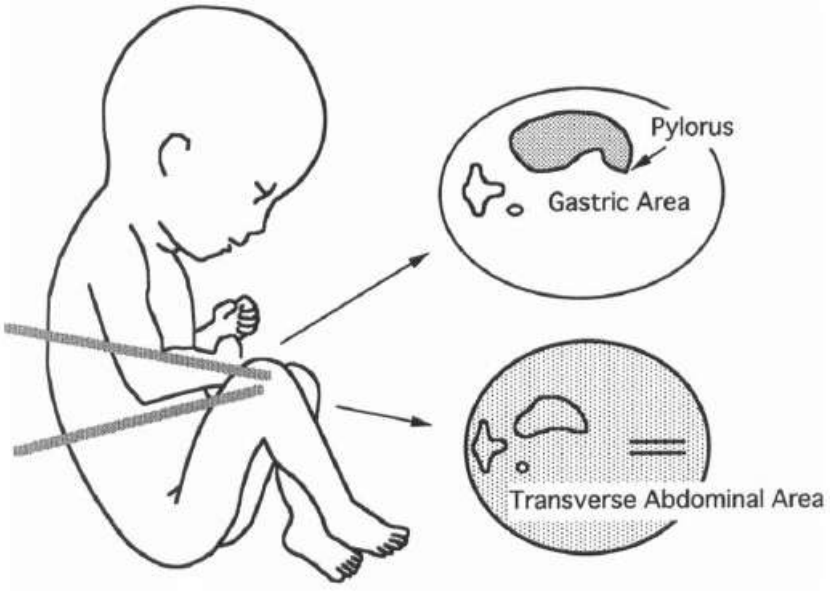


Figure 1. The schema of the fetal stomach, which is defined as the largest gastric area, inclusive of the pylorus, in relation to the transverse abdominal area [27].

note rhythmicity of fetal stomach

Sase 2005

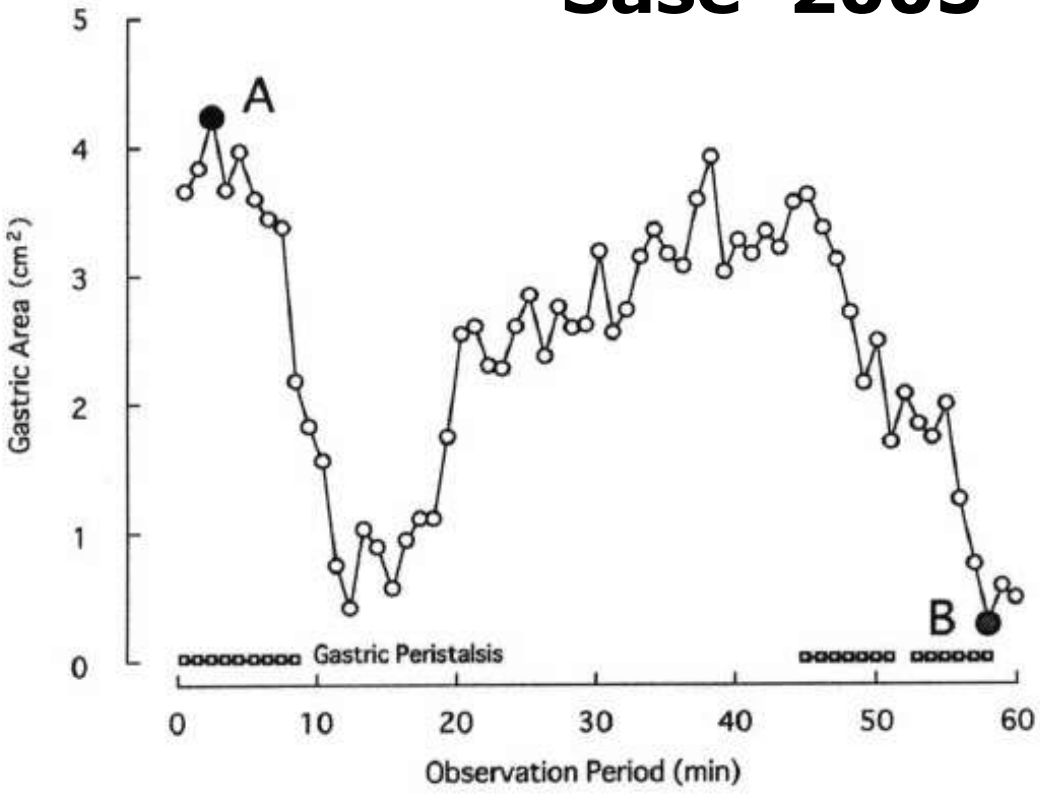
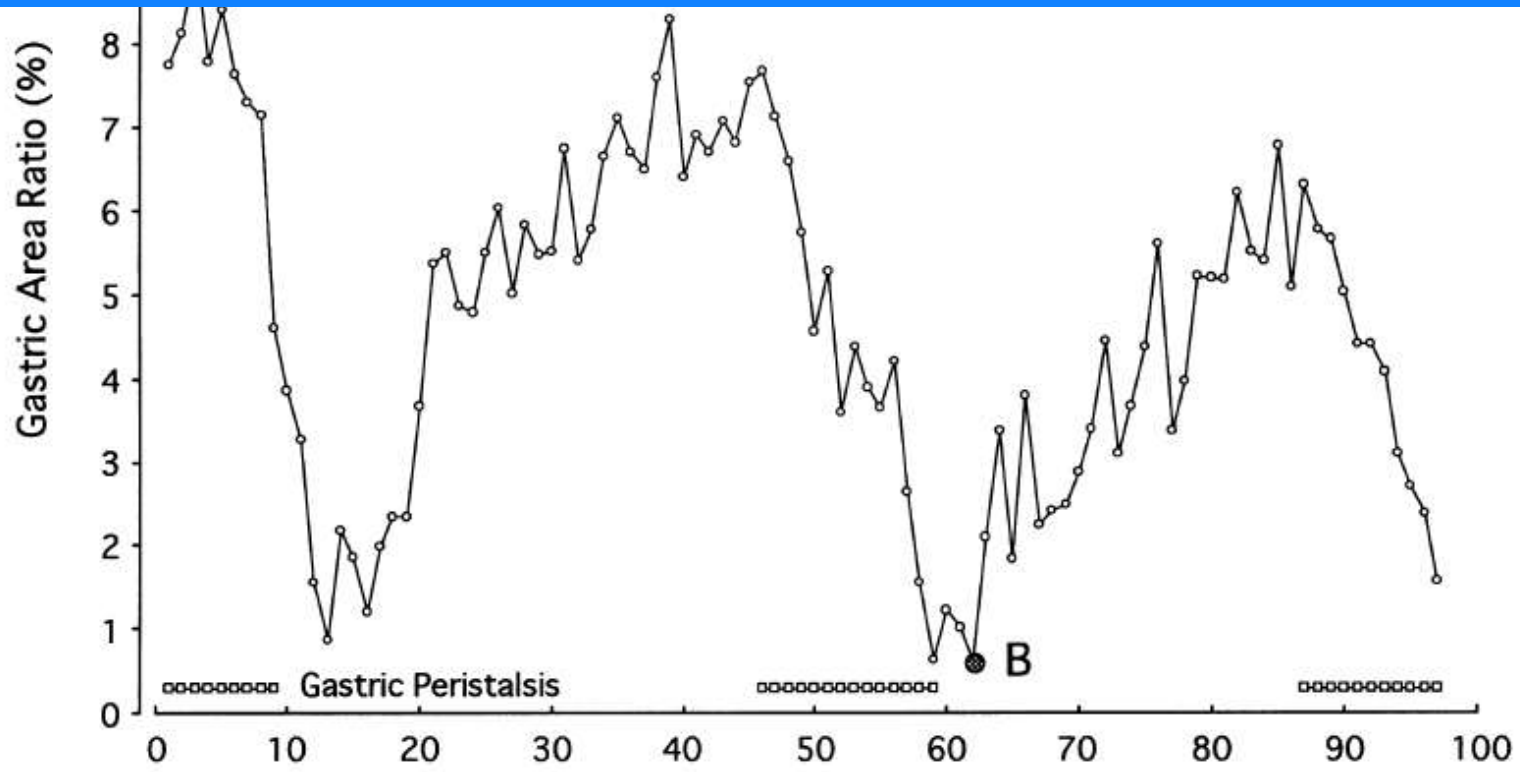


Figure 2. Changes of gastric area in a representative fetus at 33 weeks of gestation, in association with gastric peristalsis. The maximum gastric area (A) and the minimum gastric area (B) [27].

12 - 15 ml volumes at term.



note rhythmicity
of fetal stomach → 40 - 50 minutes

Pleasurable feeding
- and sleeping -
a physiological rhythm for premature infants.

note rhythmicity
of fetal stomach → 40 - 50 minutes

Pleasurable feeding
- and sleeping -
a physiological rhythm for premature infants.

Sleep cycling → 50 - 70 minutes

note rhythmicity
of fetal stomach → 40 - 50 minutes

Gastric overfilling syndrome?

Excessive volumes

reflux, aspiration, colic

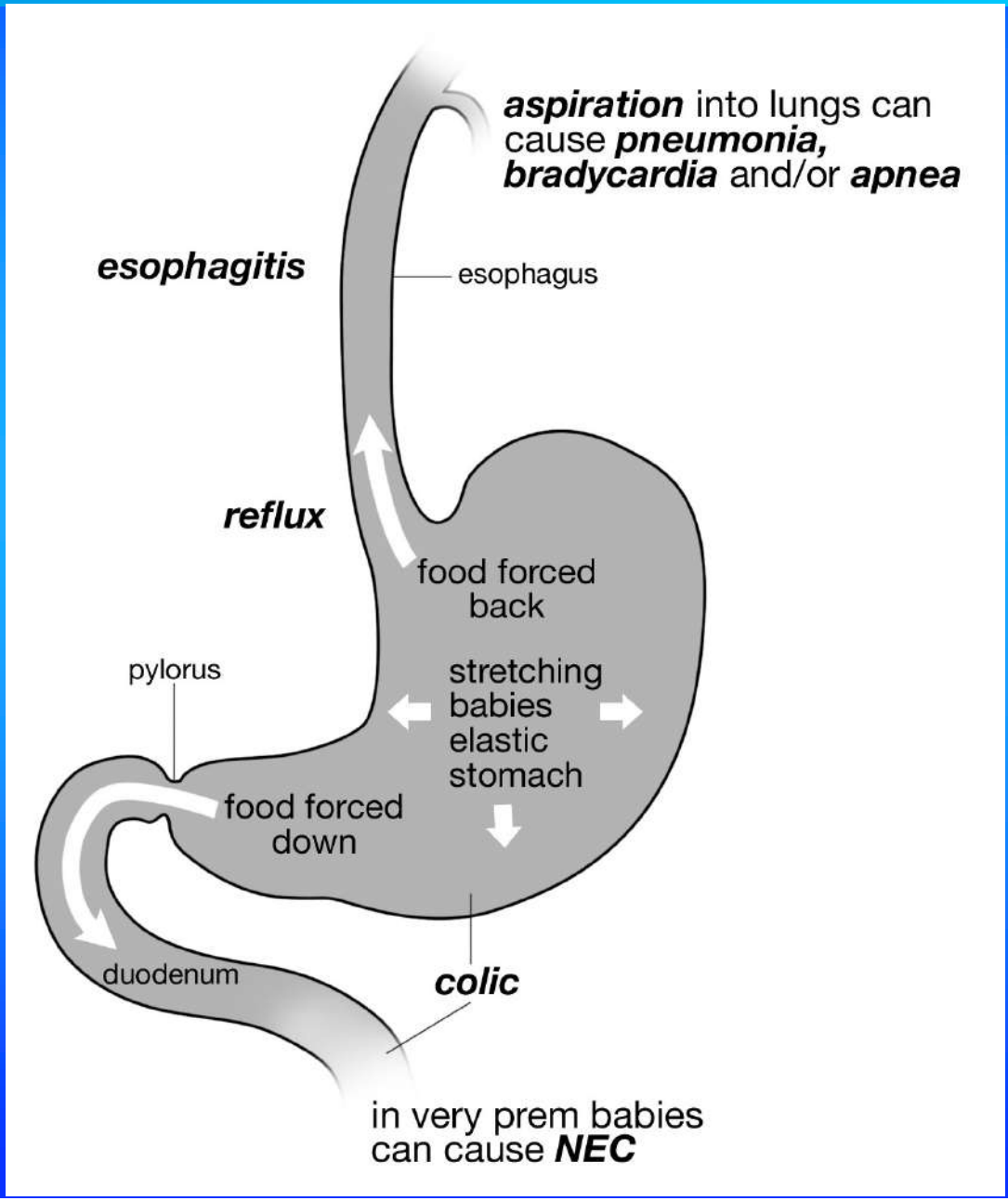
Excessive time interval

hypoglycaemia

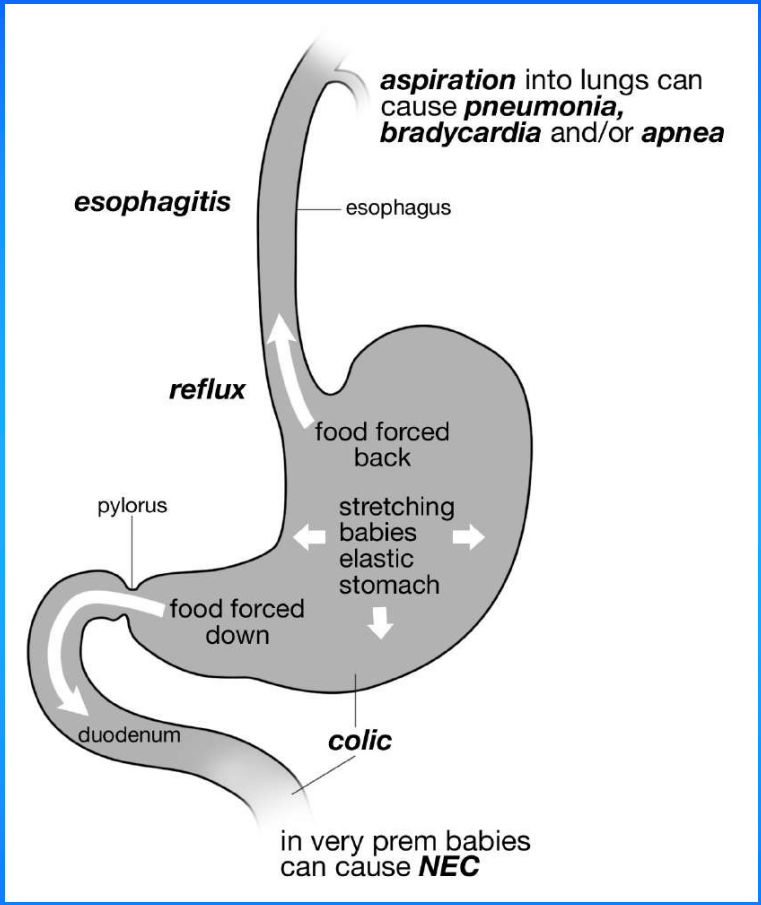
Adaptations

diabetic diathesis, obesity

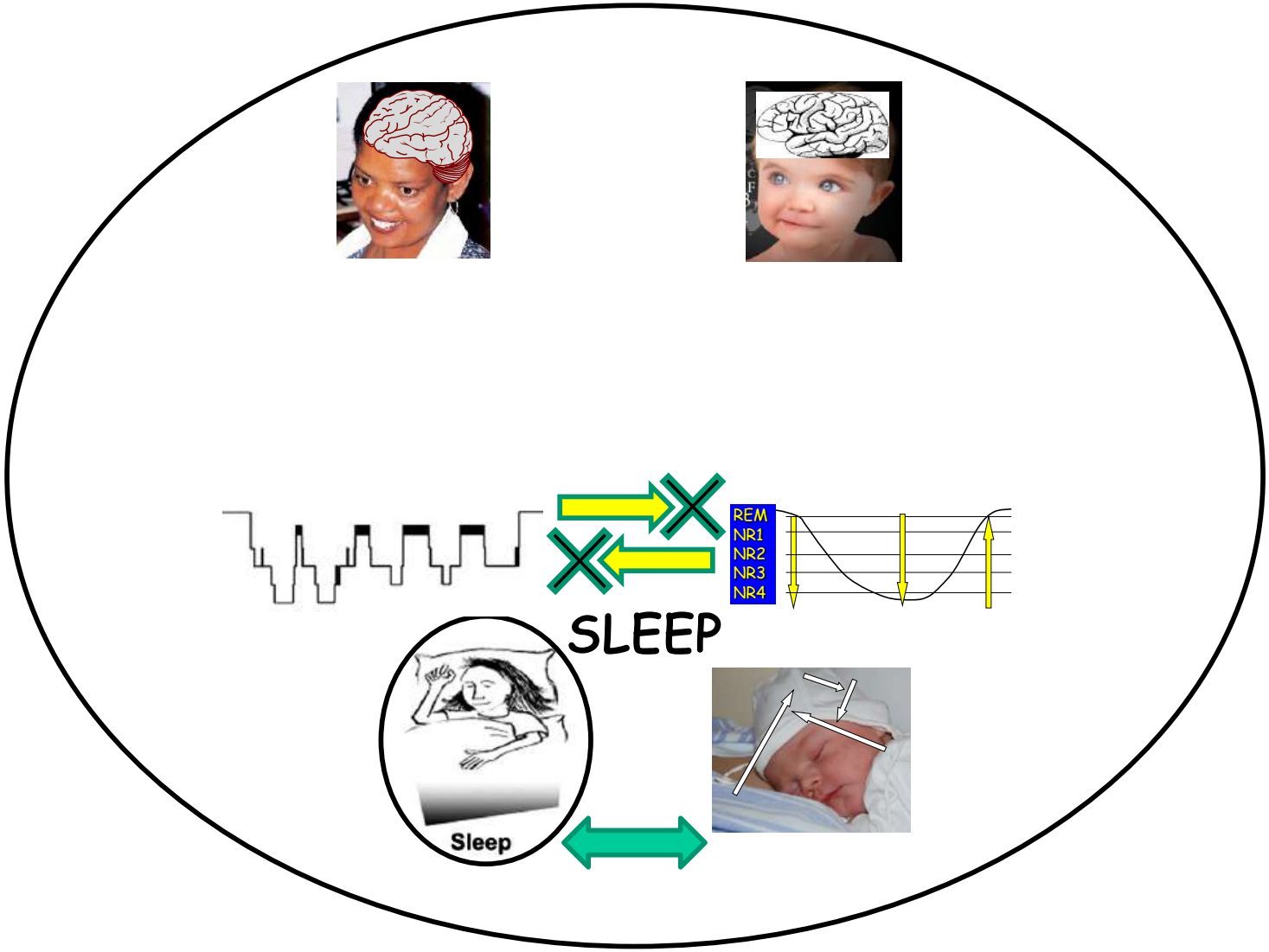
Gastric overfilling syndrome?

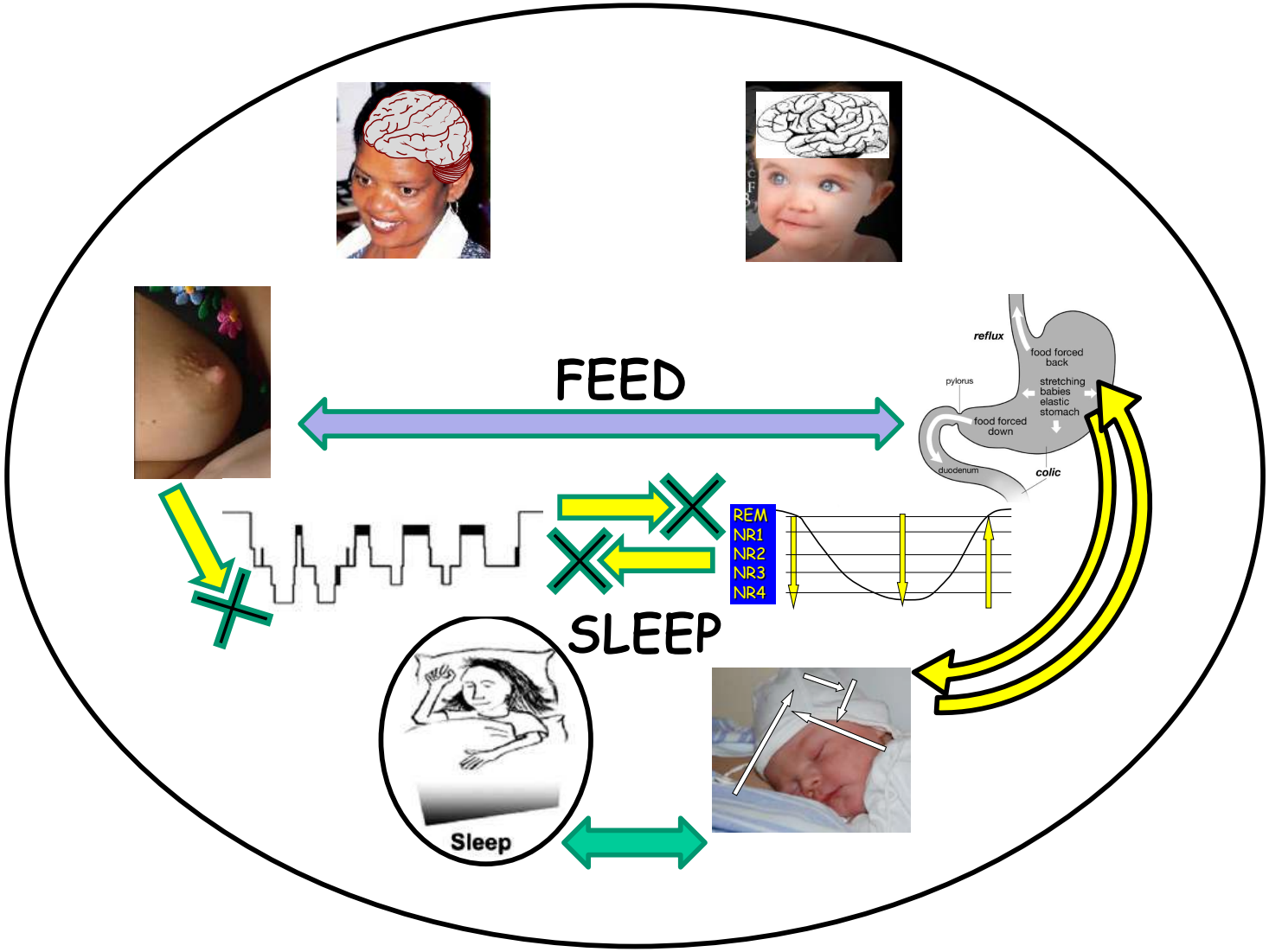


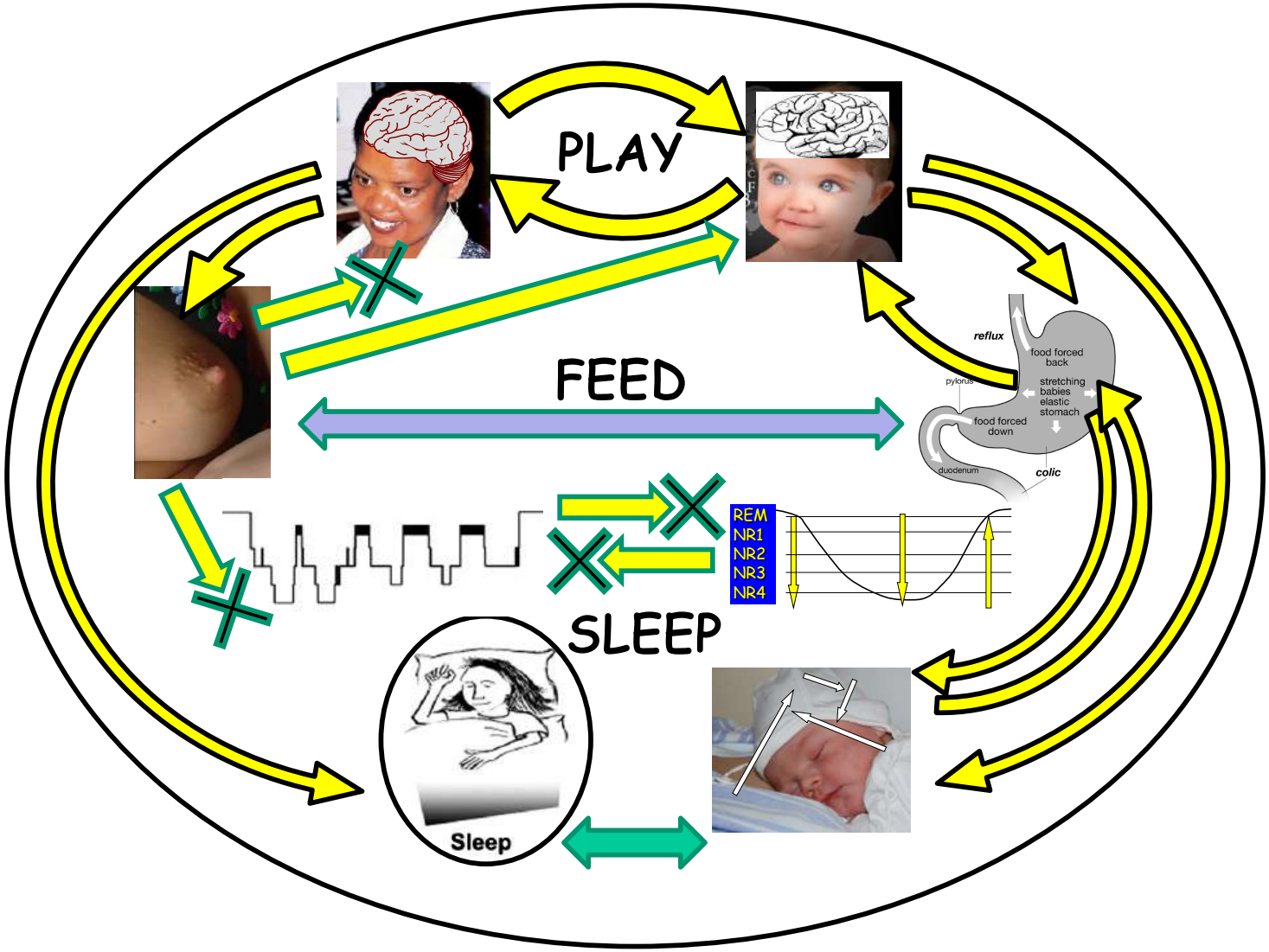
Gastric overfilling syndrome?

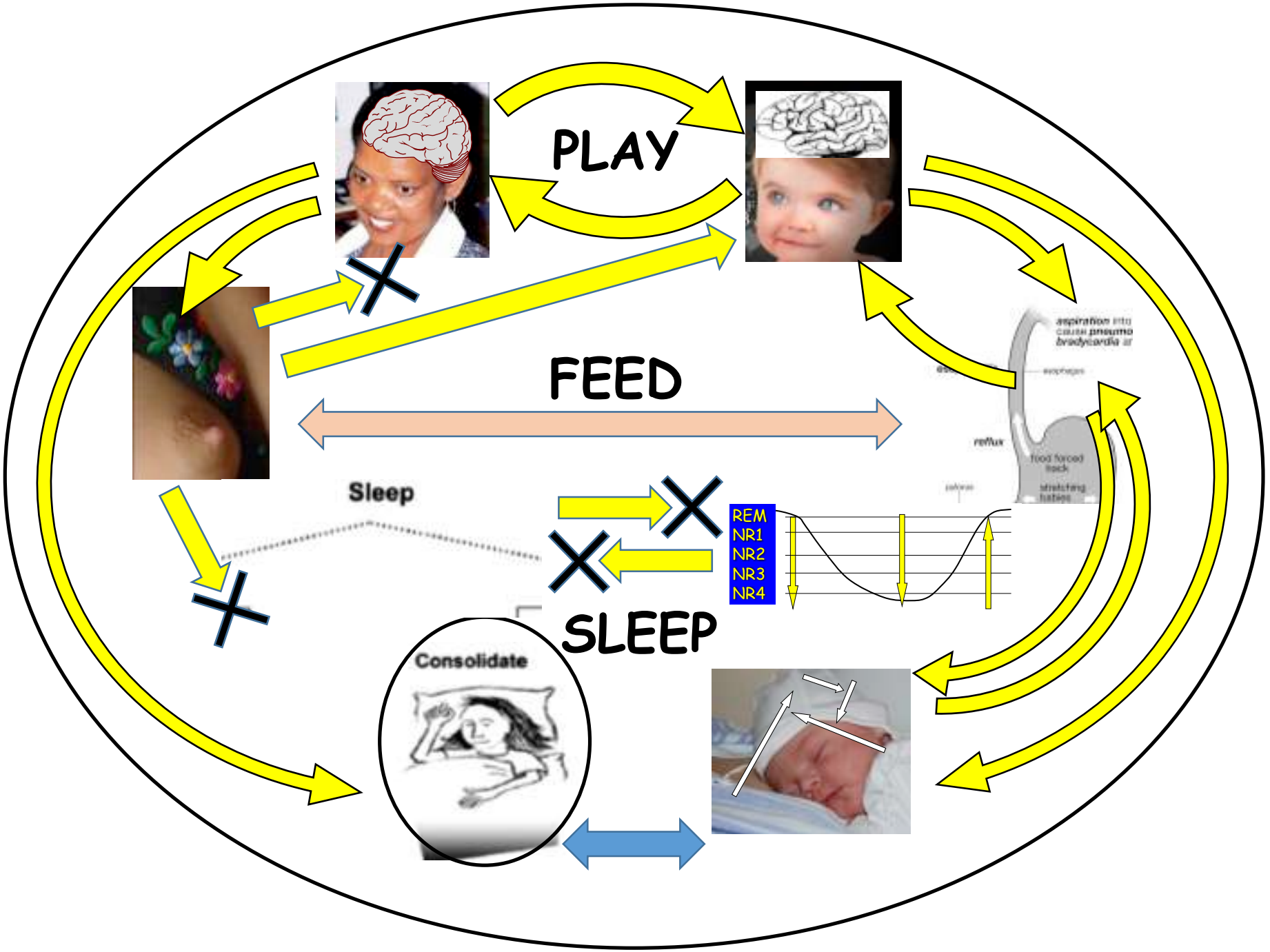


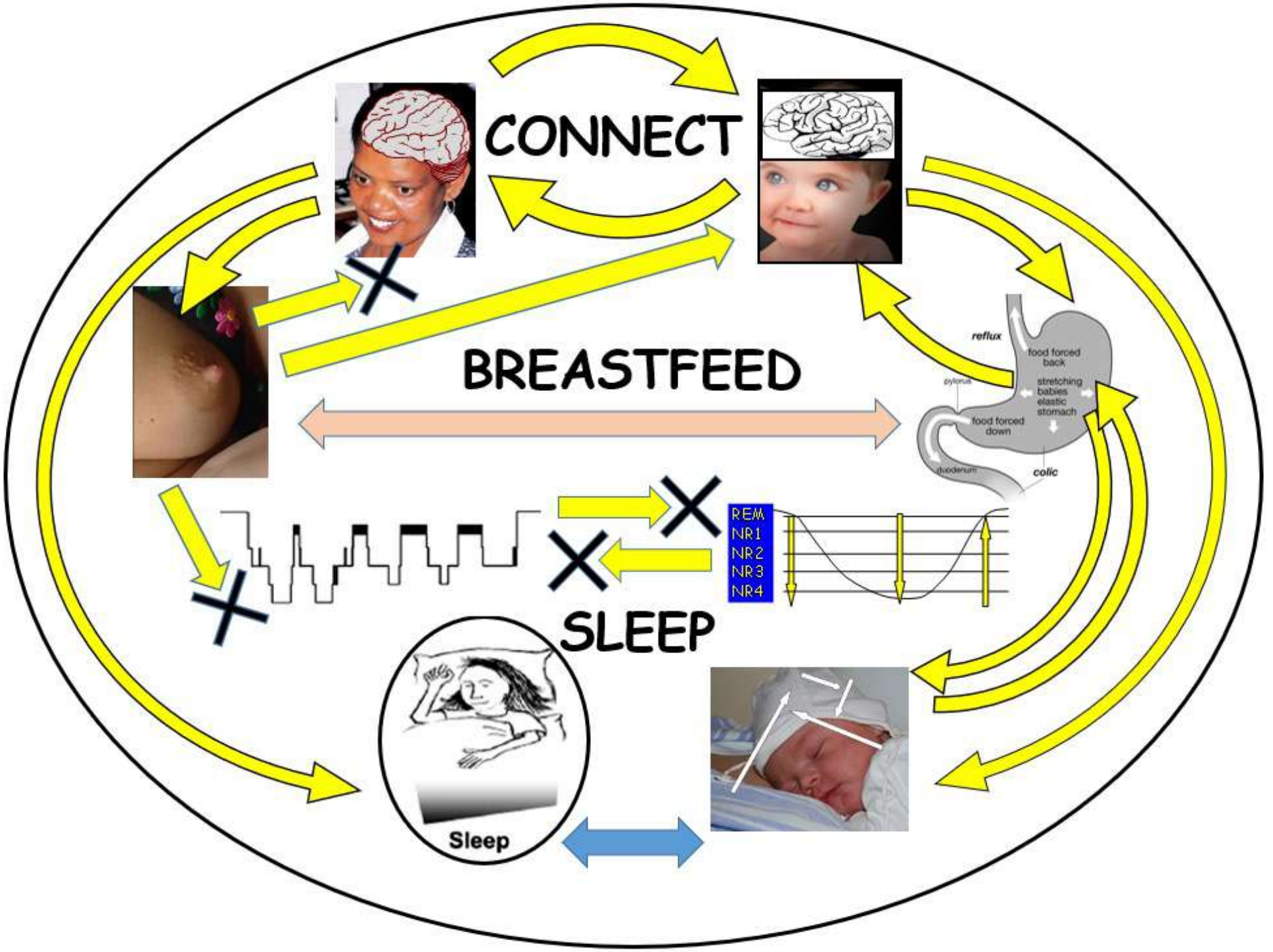
Proposed Management →


REM
NR1
NR2
NR3
NR4
SLEEP
Sleep


FEED
reflux
food forced back
pylorus
stretching babies elastic stomach
food forced down
duodenum
colic
REM
NR1
NR2
NR3
NR4
SLEEP
Sleep


PLAY
FEED
SLEEP
reflux
food forced back
pylorus
stretching babies elastic stomach
food forced down
duodenum
colic
REM
NR1
NR2
NR3
NR4
Sleep

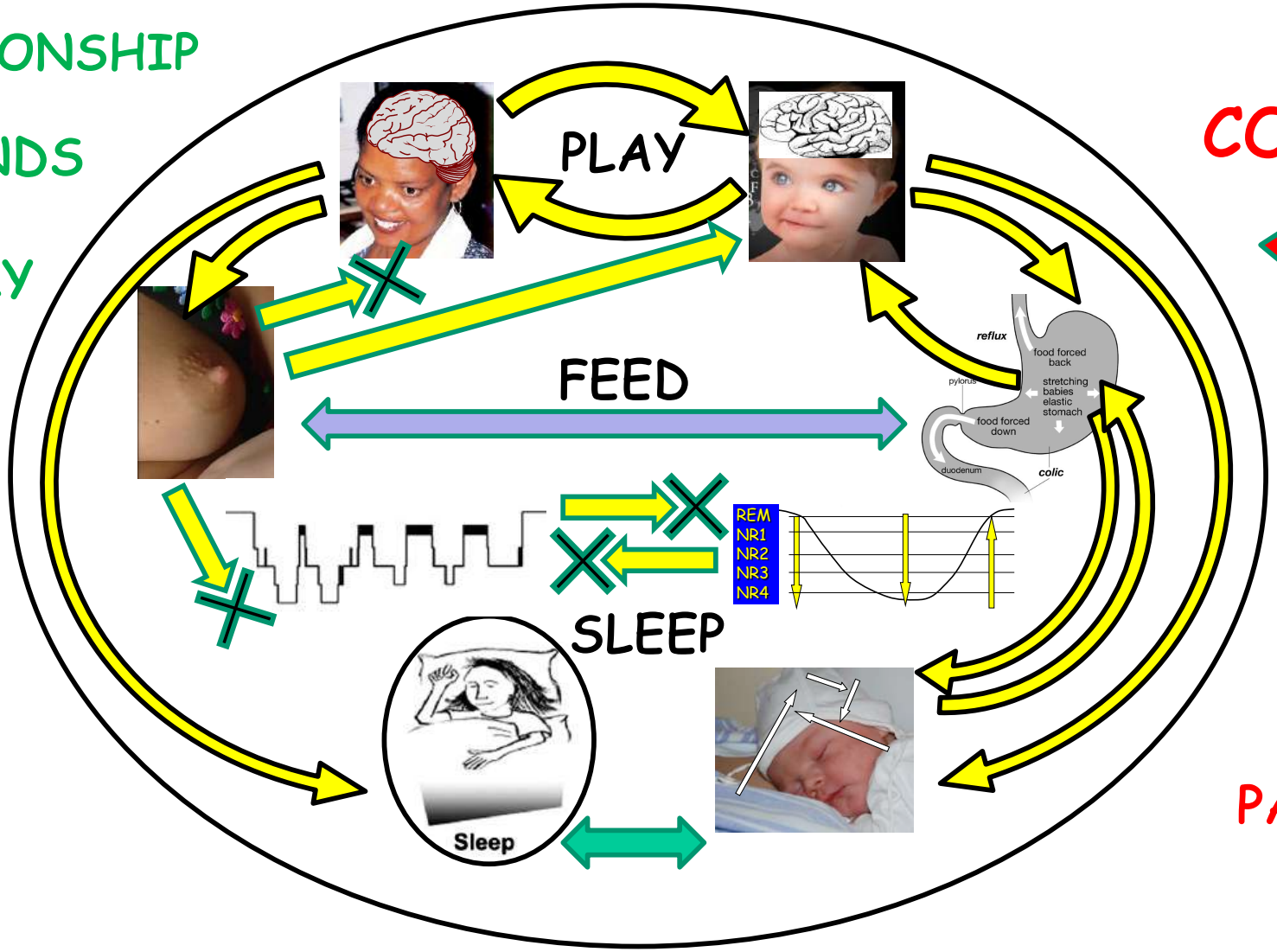

PLAY
FEED
Sleep
SLEEP
REM
NR1
NR2
NR3
NR4
Consolidate


CONNECT
BREASTFEED
reflux
food forced back
stretching babies elastic stomach
food forced down
pylorus
duodenum
colic
REM
NR1
NR2
NR3
NR4
SLEEP
Sleep

RELATIONSHIP

FRIENDS

FAMILY



CONTROL

TOYS

WORK

PACIFIER

Consolidation of dyadic lifestyle leads to emotional and social competence

Amygdala

SSC

says "mother"

PFOC

Amygdala *says "safe"*

SSC *says "mother"*

Visual cortex

PFOC *says "approach"*

Amygdala *says "safe"*

SSC *says "mother"*

Eyes

Visual cortex — *says "open eyes"*

PFOC — *says "approach"*

Amygdala — *says "safe"*

SSC — *says "mother"*

Eyes — *say "contact"*

↑

Visual cortex — *says "open eyes"*

↑

PFOC — *says "approach"*

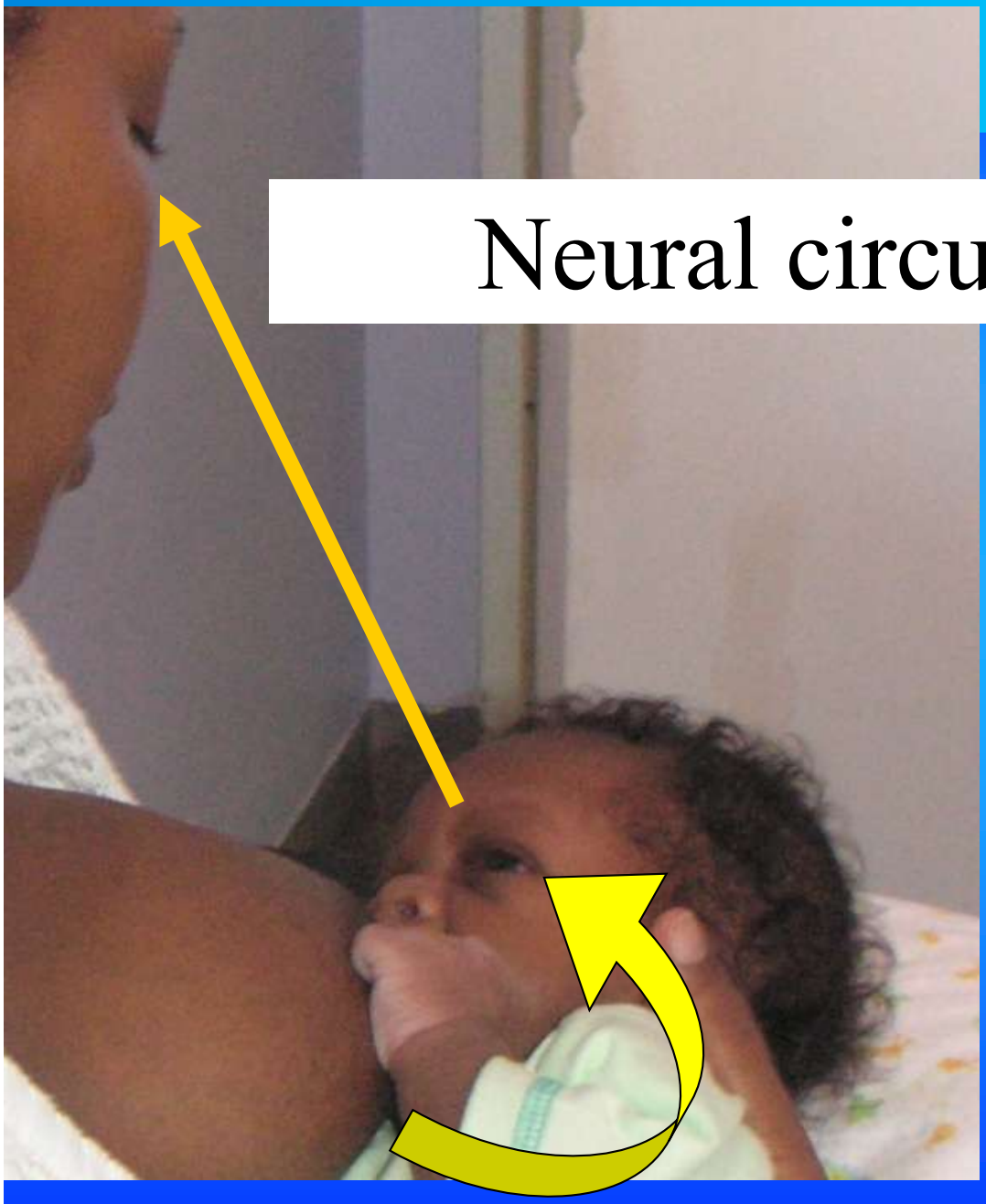
↑

Amygdala — *says "safe"*

↑

SSC — *says "mother"*

Neural circuitry of bonding



Eyes — *say "contact"*

↑

Visual cortex — *says "open eyes"*

↑

PFOC — *says "approach"*

↑

Amygdala — *says "safe"*

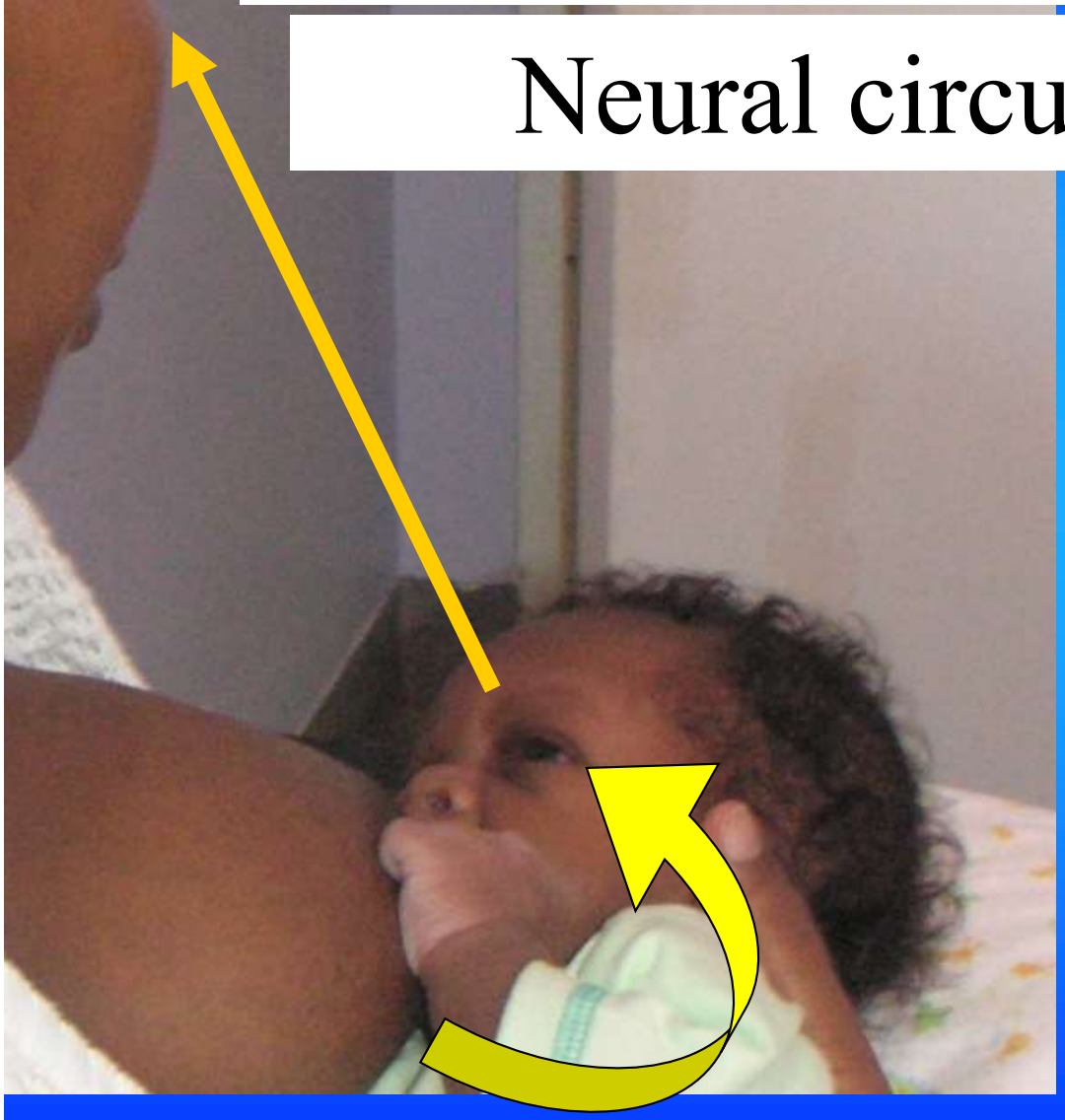
↑

SSC — *says "mother"*

Psalm 22 v 9

"I learnt trust on my mother's breasts"

Neural circuitry of bonding



Eyes — *say "contact"*

↑

Visual cortex — *says "open eyes"*

↑

PFOC — *says "approach"*

↑

Amygdala — *says "safe"*

↑

SSC — *says "mother"*

Psalm 22 v 9

"I learnt trust on my mother's breasts"

"trust" (baṭach)
to *hie* for refuge; figuratively to *trust*,
be bold (confident, secure, sure),
(make to hope, make to trust.)

"breast" (shoḏ)
the *breast* of a woman
or animal (as *bulging*):
- breast, pap, teat.

Psalm 22 v 9

"I learnt trust on my mother's breasts"

Instituto Europeo de
Salud Mental Perinatal

… with focus on long term mental health benefits.