Joint Graduate Seminar 2017
Department of Microbiology
Faculty of Medicine
The Chinese University of Hong Kong

Follow Your Gut Feeling – Gut Microbiota and Brain

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Year : Year 4
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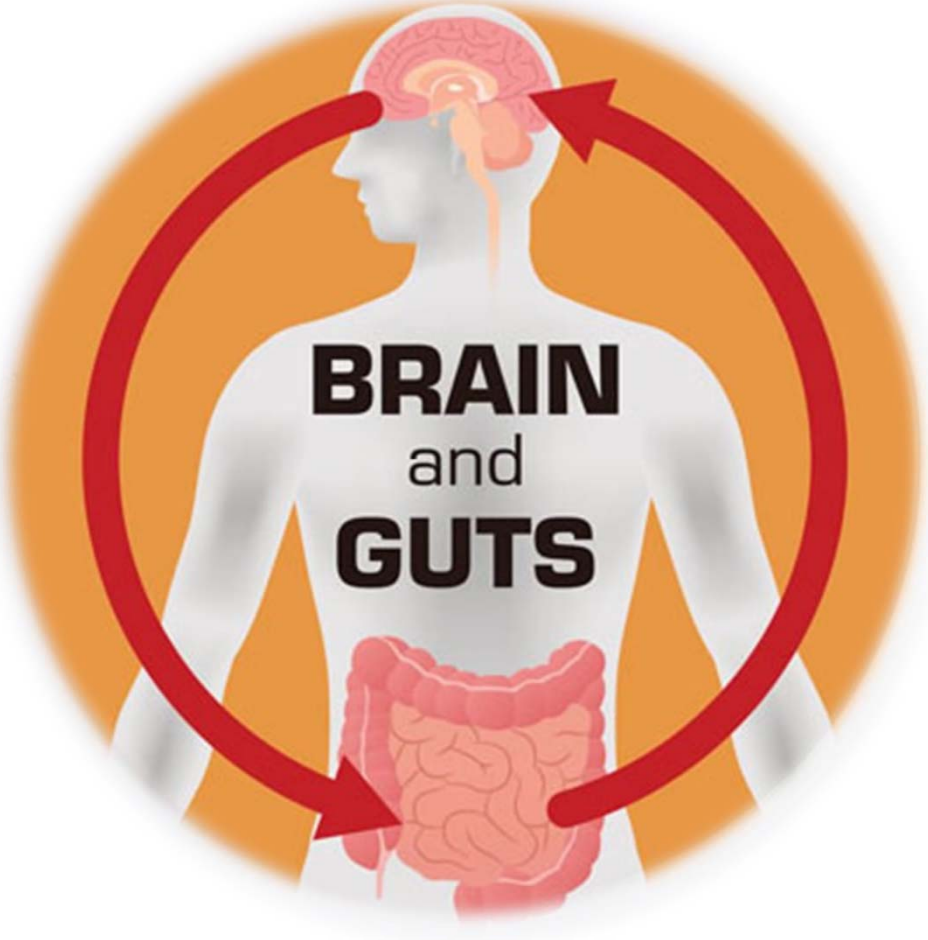
Are we really humans in cellular level?



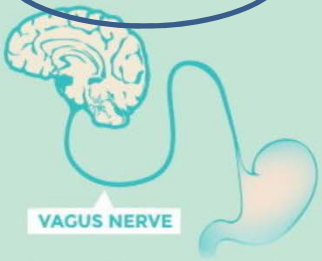
How do brain and gut microbiota communicate?

From Brain to Gut Microbiota

From Gut Microbiota to Brain

How do brain and gut microbiota communicate?

Neural



Microbial compounds communicate with the brain via the vagus nerve

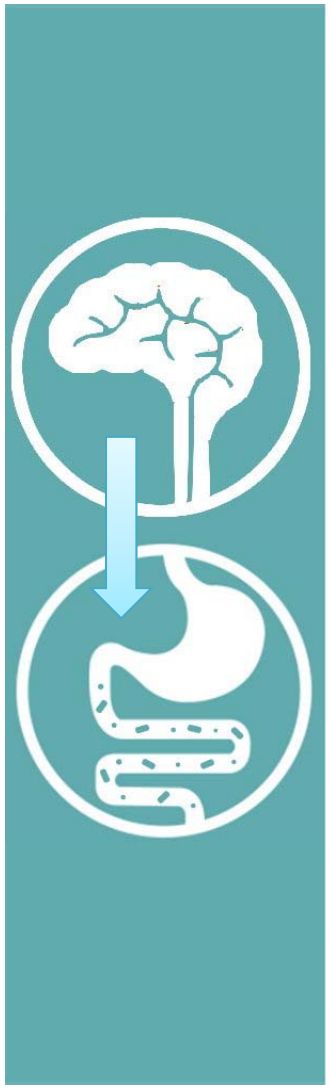
Immune

Gut microbes interact with the immune system which communicates with the brain

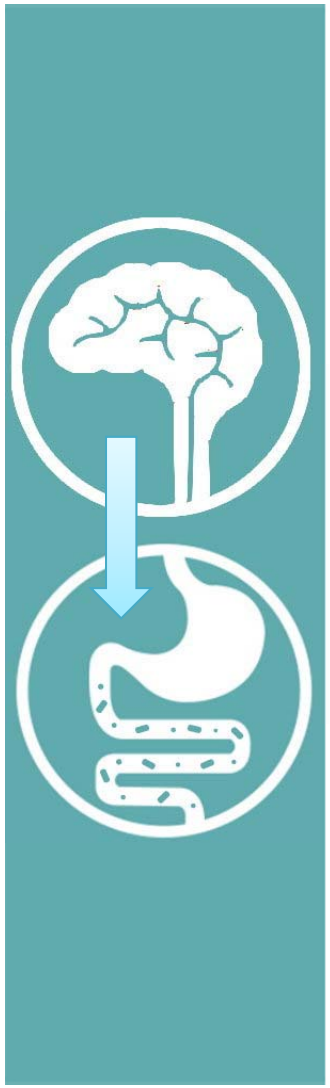
Circulatory

The gut releases hormones and neuroactive compounds which travel through the blood stream

(Modified from BIMUNO)



From Brain to Gut Microbiota



1. Mood

(by Vincent J. MUSI at National Geographic Stock)

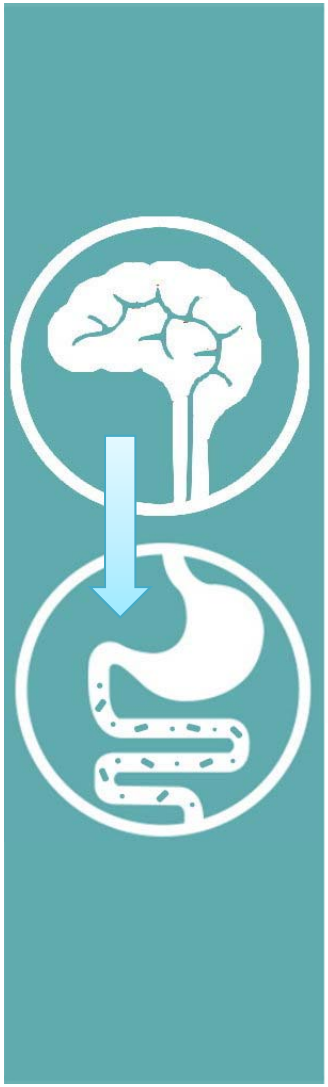
Social Disruption (SDR) Stressor Test

Placing an **aggressive** male mouse into the home cage of the resident mice until all **the residents are defected**

Exposure to stress

- Gut microbiota **diversity declined**
- *Clostridium* **increased**

(by Smokie at inktober-2016-10-butterflies-in-your-stomach)



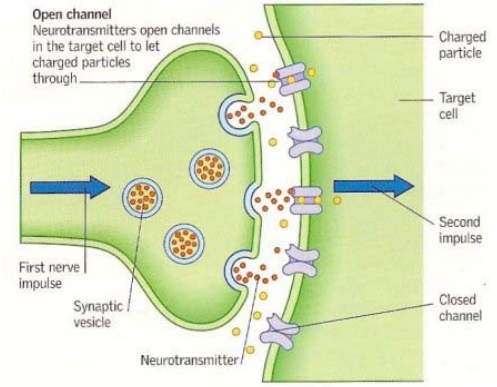
1. Mood

Gut Function Regulation

- Motility
- Acid secretion
- Bicarbonates generation
- Mucus production …

Suitable Environment

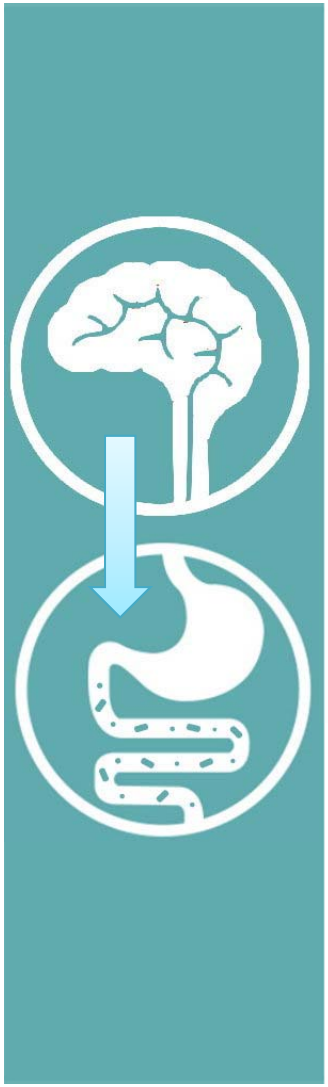
Neurotransmitter Secretion



- *Lactobacillus* :
  make acetylcholine and GABA
- *Pseudomonas* :
  high affinity GABA receptors
- *Escherichia coli* :
  adrenaline receptors

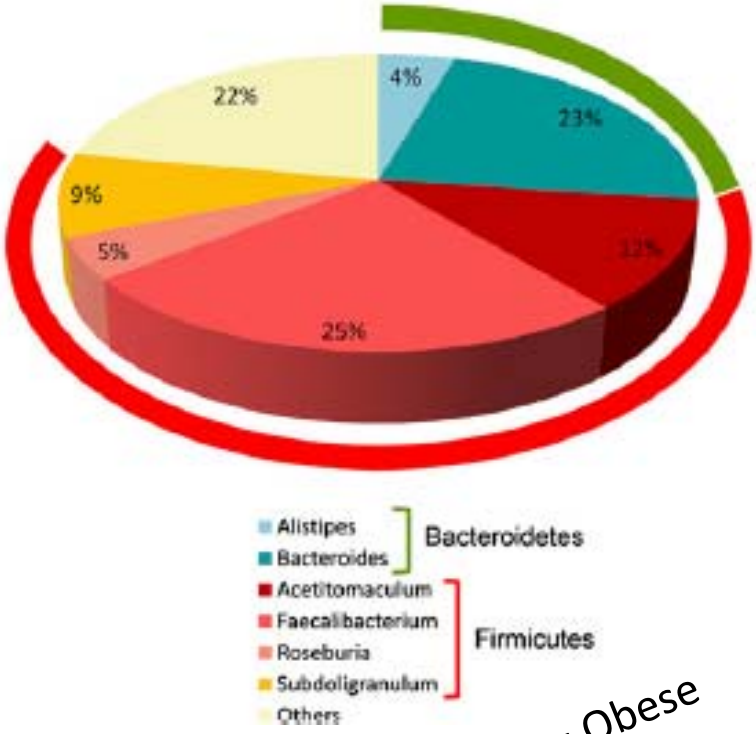
2. Diet

- Microbial richness
- Diversity



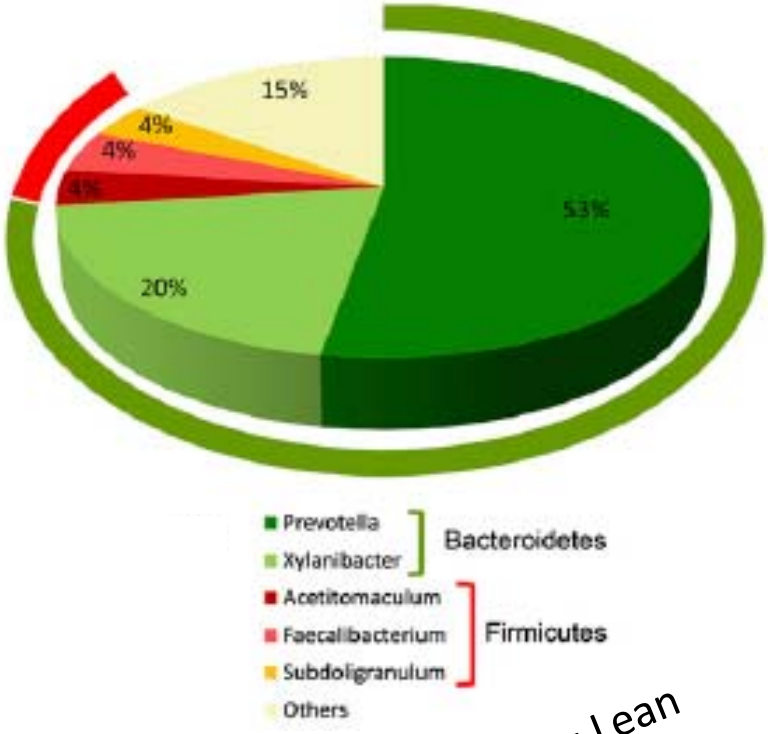
2. Diet

European children (Western diet)



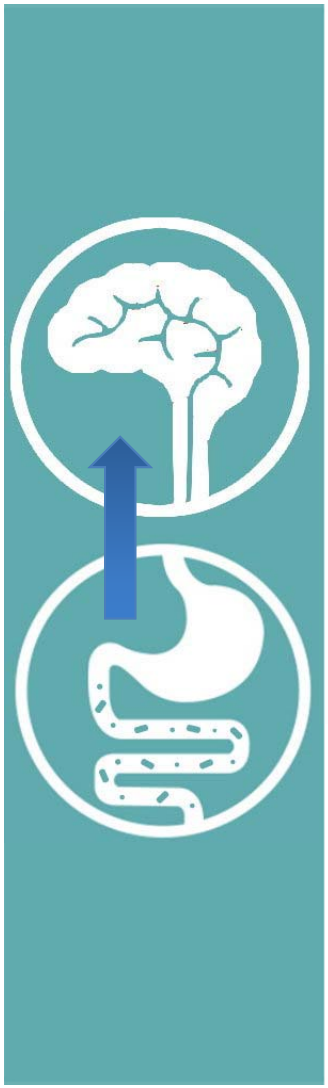
Firmicutes > Bacteroidetes = Obese

African children (Vegetarian diet)



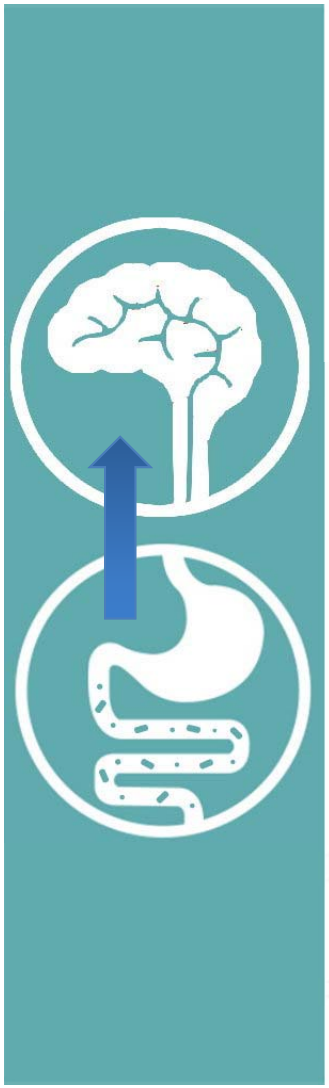
Bacteroidetes >Firmicutes = Lean

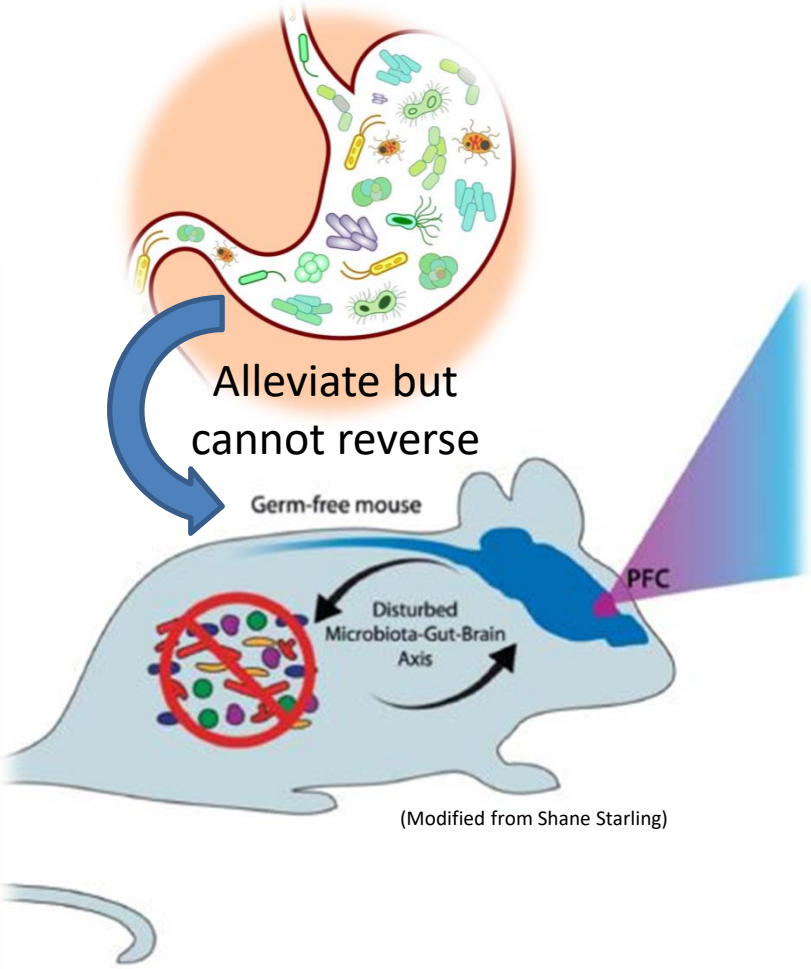
(Modified from De Filippo C et al, 2010)



From Gut Microbiota To Brain

A. Brain Development

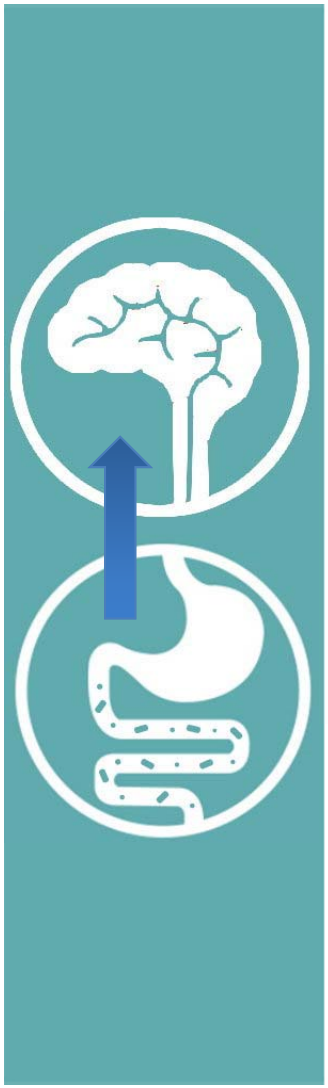




(Modified from Shane Starling)

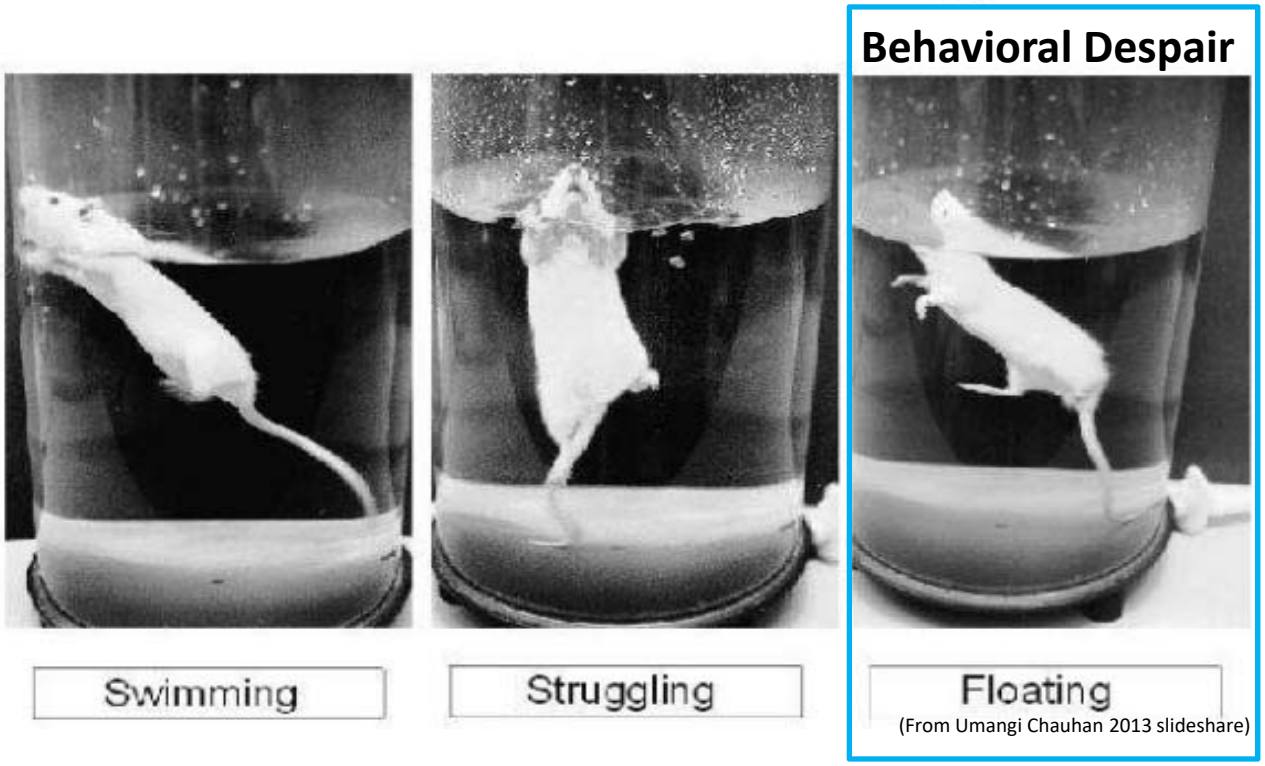
- Elevated bloodstream corticosterone
- Lower serotonin level
- Lower amount of serotonin receptors in amygdala
- Lower expression of brain-derived neurotrophic factor (BDNF) mRNA in hippocampus

Certain neurological developments are likely programmed by gut microbiota during fetal development or in adolescence.

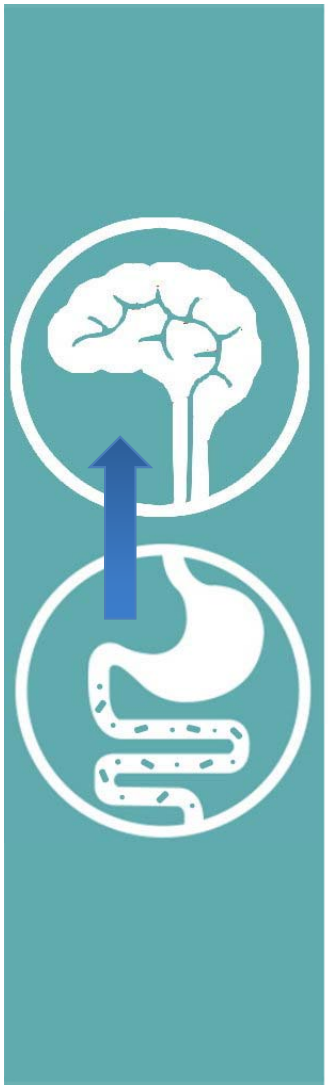


B. Emotional Regulation

Forced Swimming



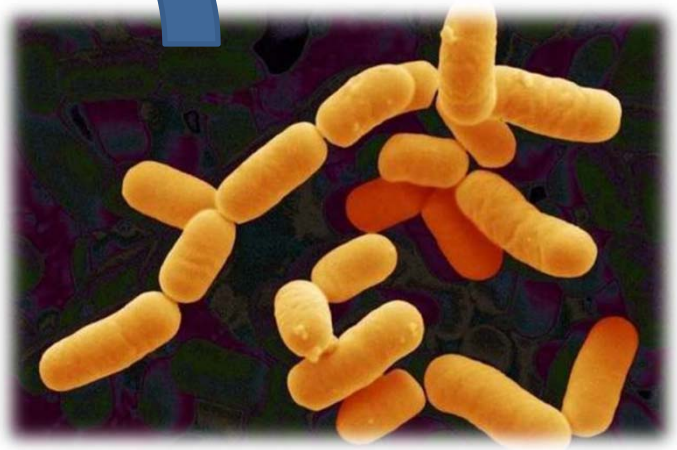
The shorter time the mice have behavioral despair,
the better is the antidepressant effect.



B. Emotional Regulation

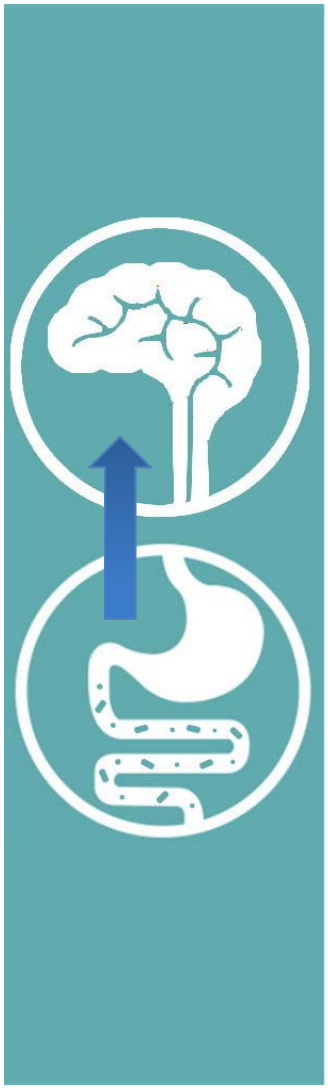
GABA

(By PORSPLT)



Lactobacillus

- Longer swimming
- Less time in behavioral despair



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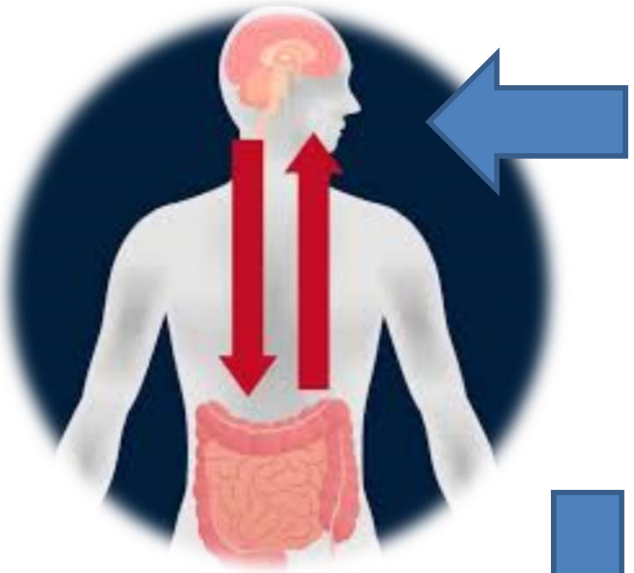
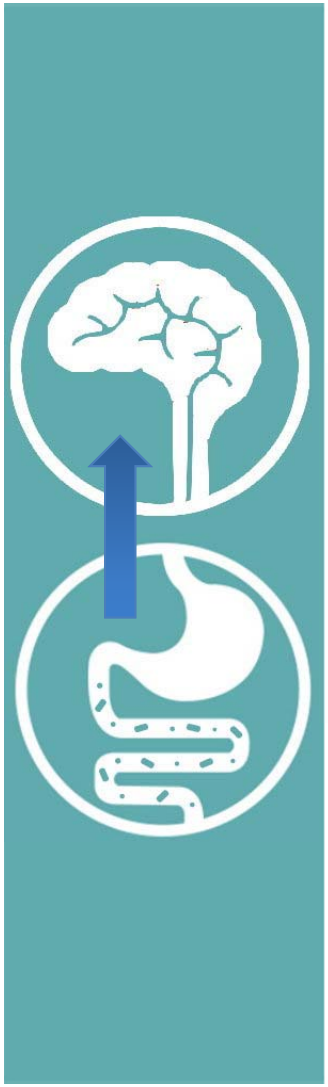


Lactobacillus

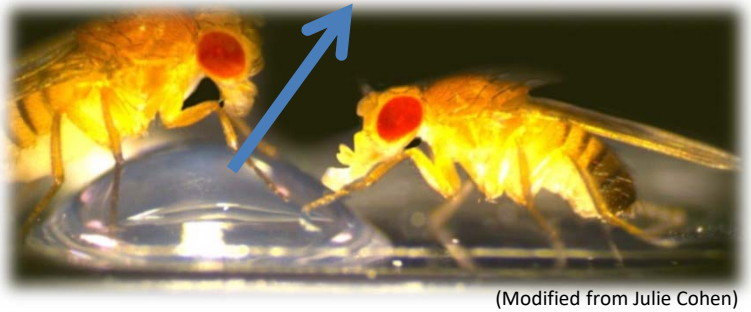
Bifidobacterium

- Lower mental stress
- Better emotional control
- Better cognitive abilities



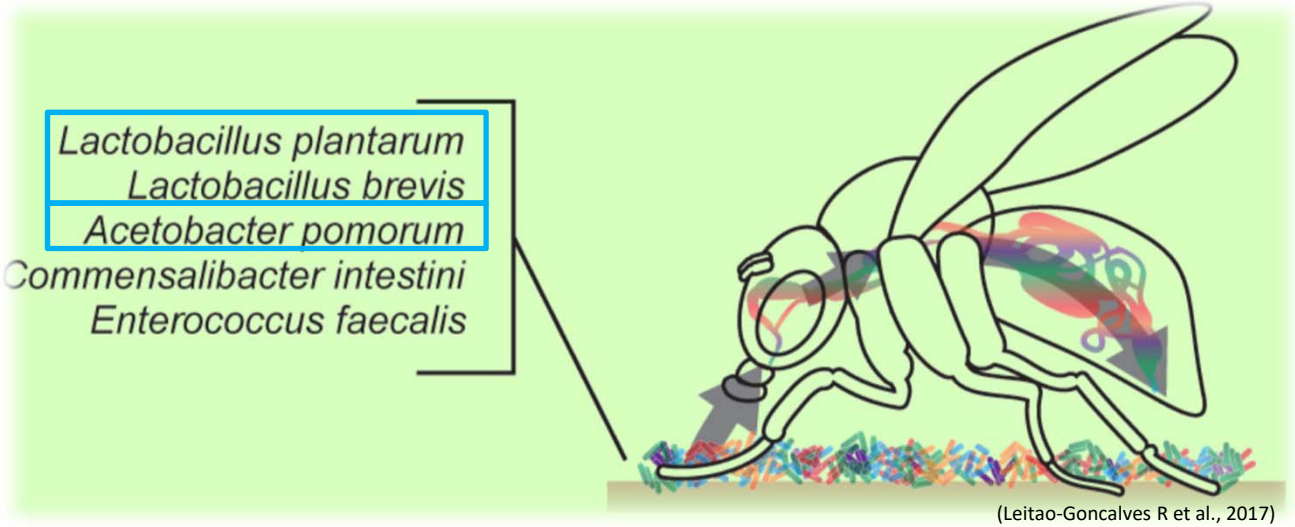
C. Eating

X Essential amino acids

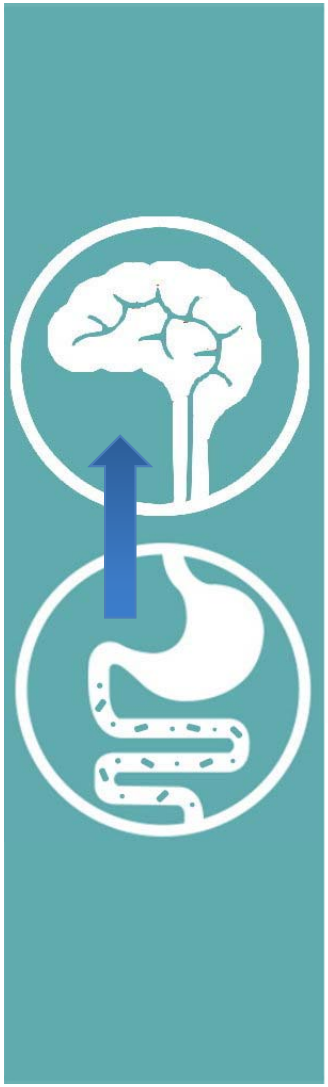


(Modified from Julie Cohen)

Strong and specific appetite for protein-rich food



(Leitao-Goncalves R et al., 2017)



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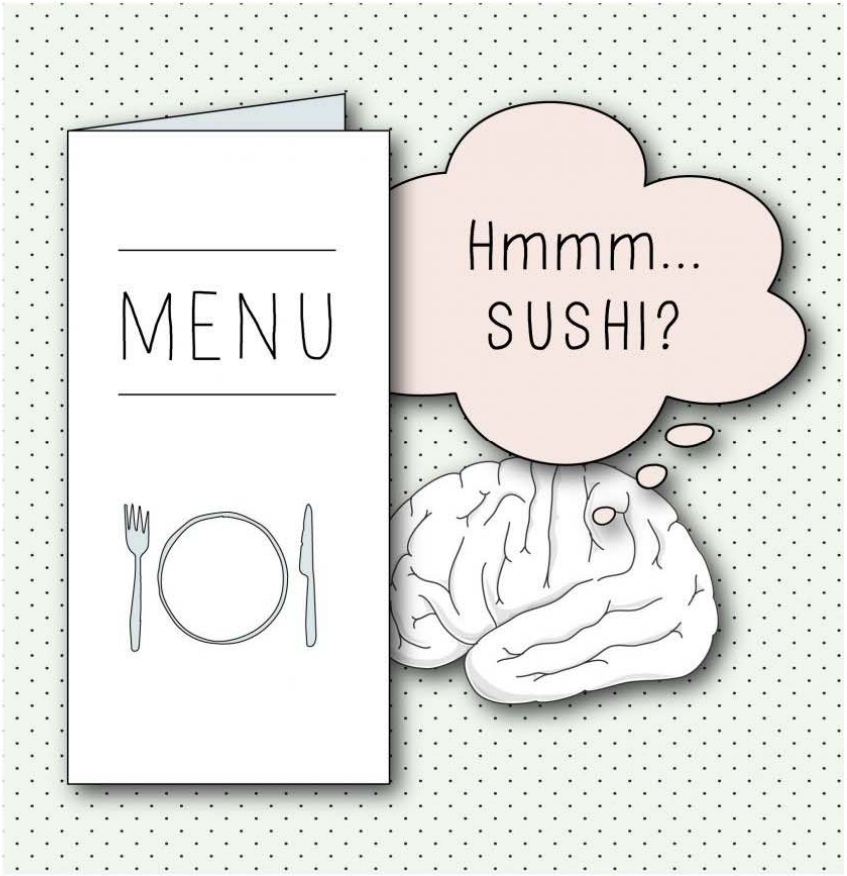
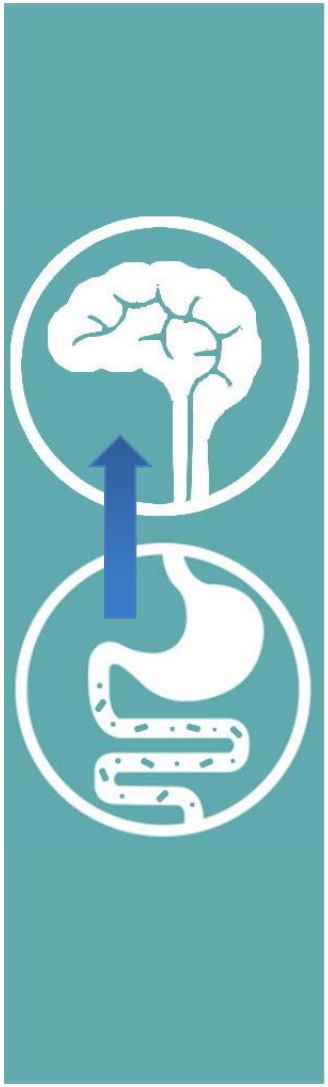
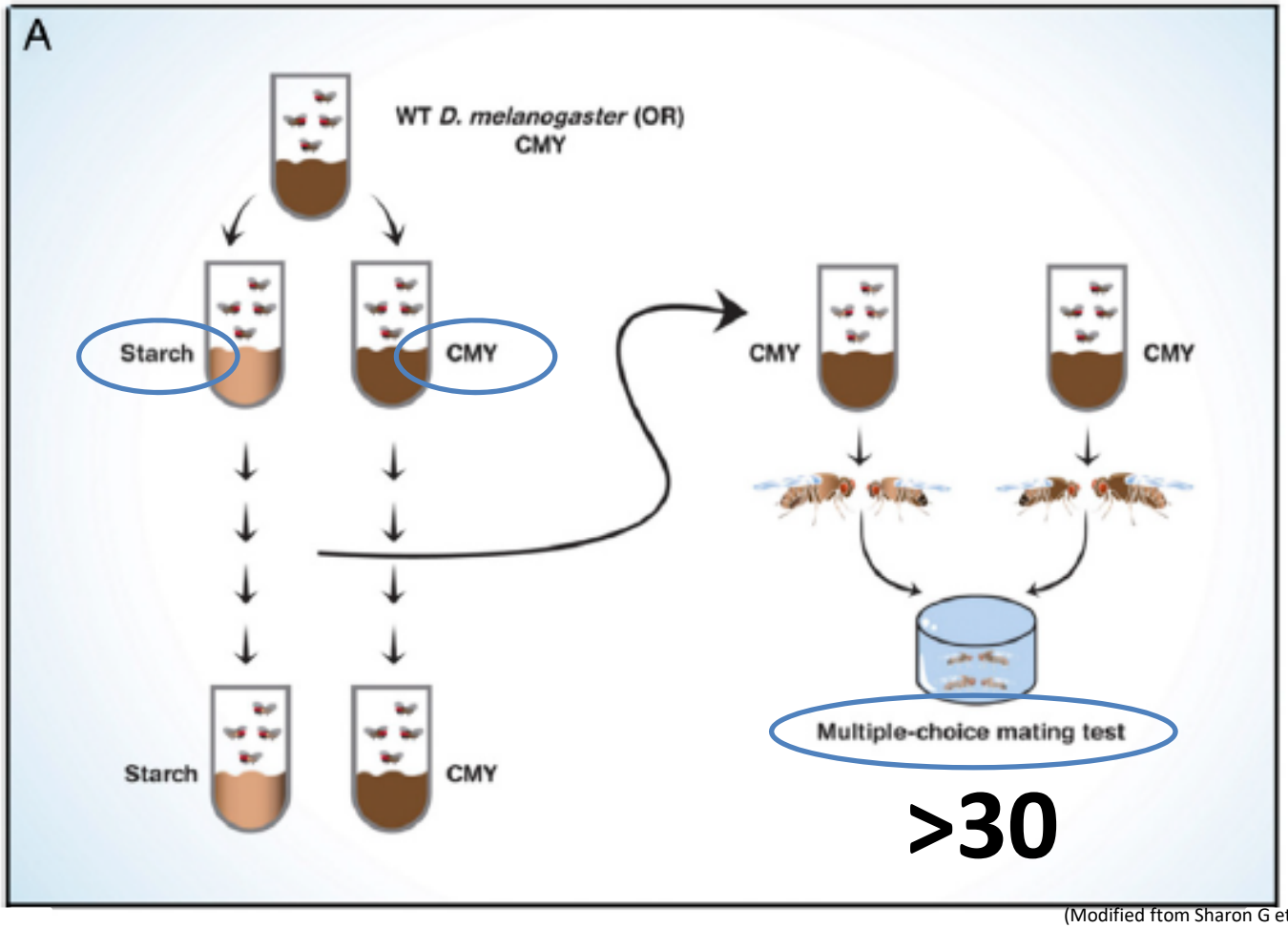


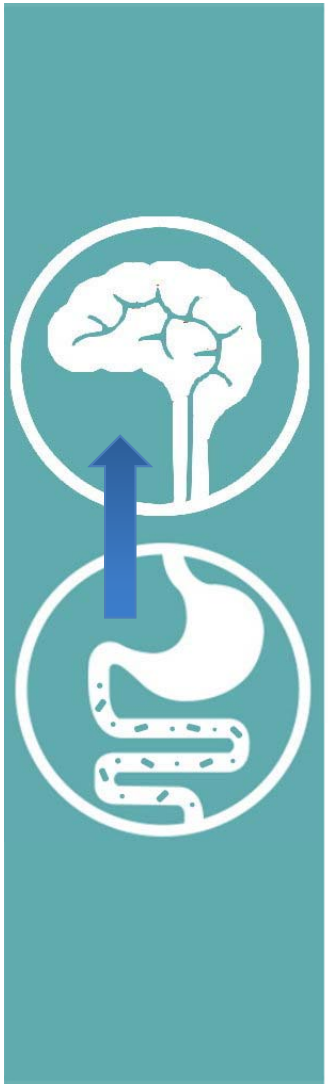
(By Gil Costa)



D. Mating



(Modified ftom Sharon G et al., 2010)



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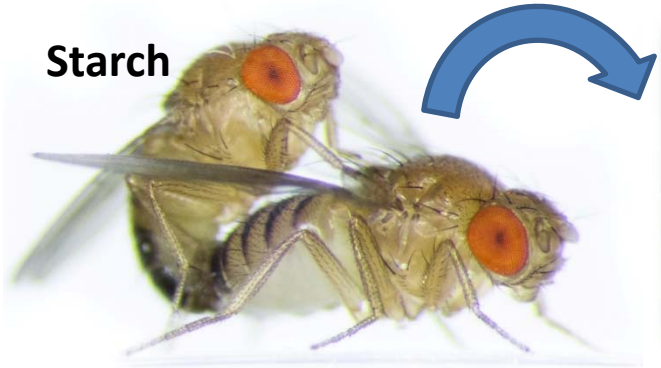
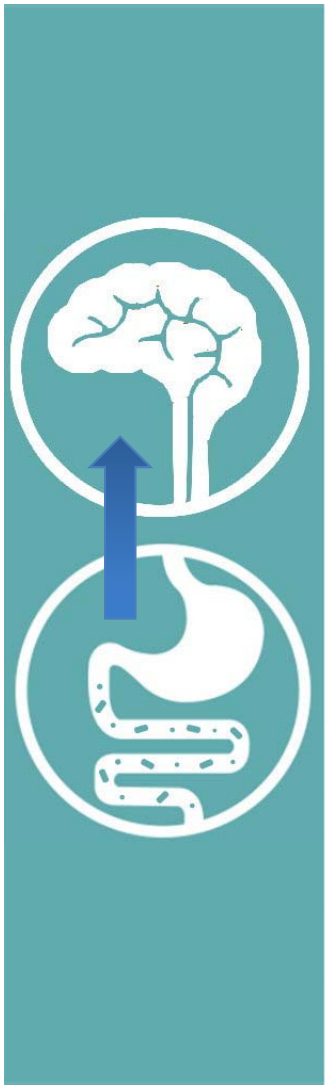


(By Amy Xinyang Hong & Cedric Tan)

Lactobacillus plantarum

(By Amy Xinyang Hong & Cedric Tan)



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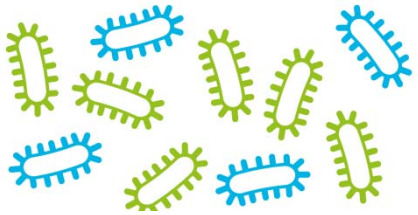
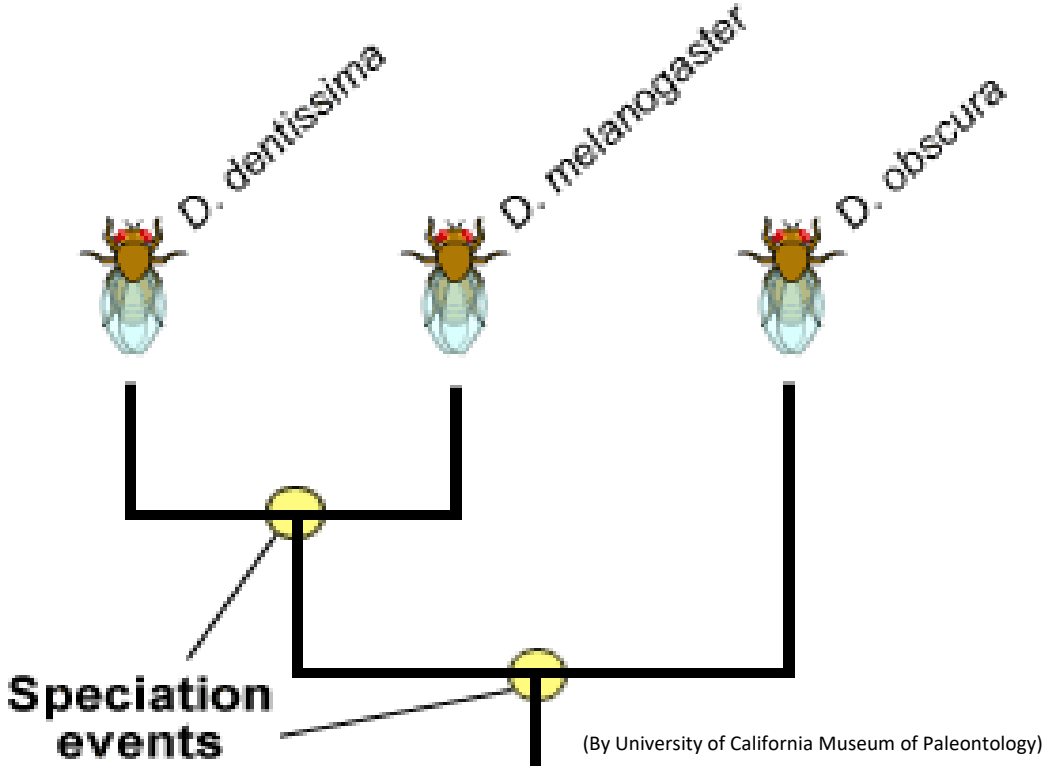
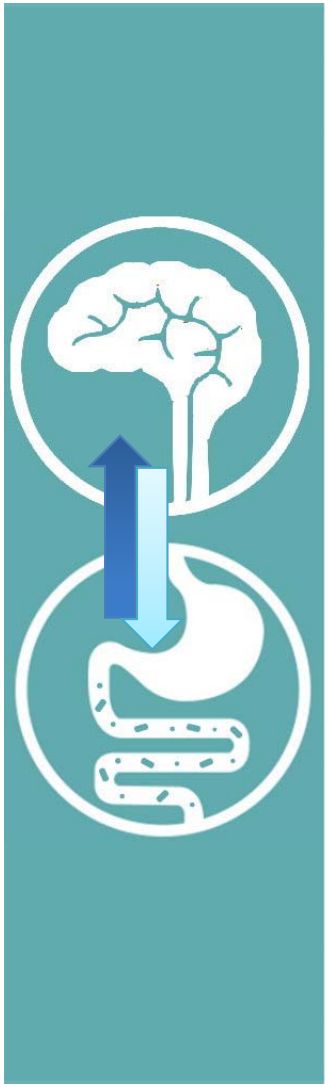


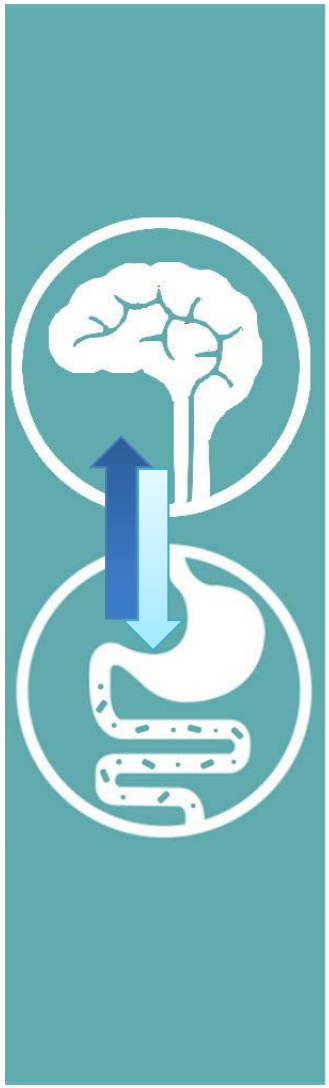
Hydrocarbon sex pheromone level alteration



(By University of California Museum of Paleontology)



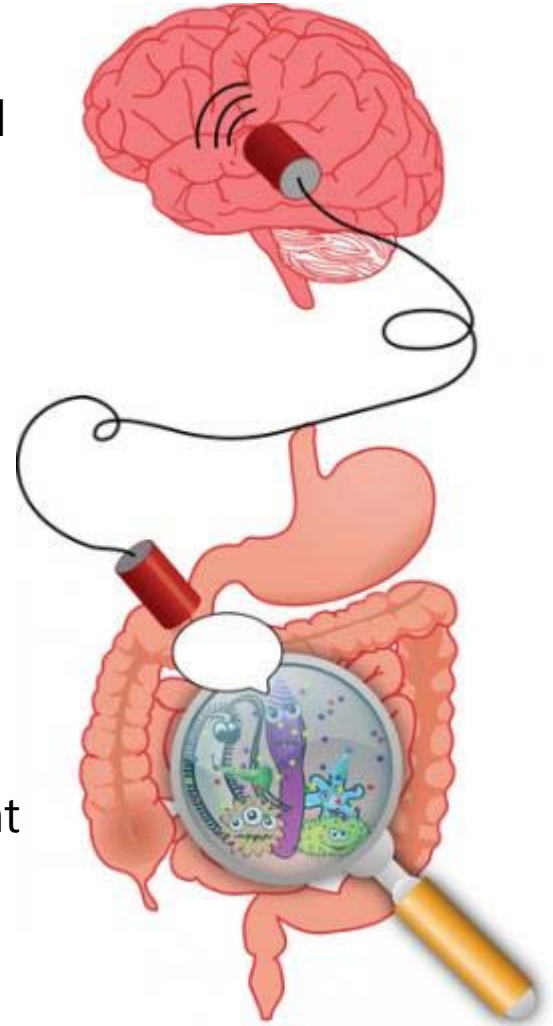
Summary



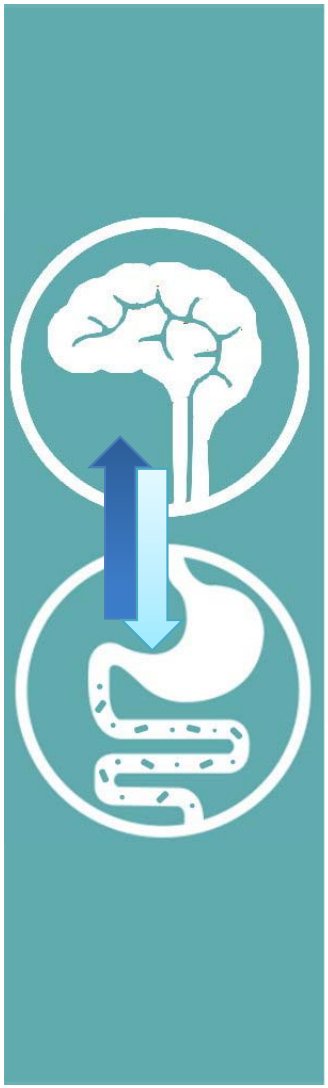
Essential for our physical and mental health

Follow your gut feeling!

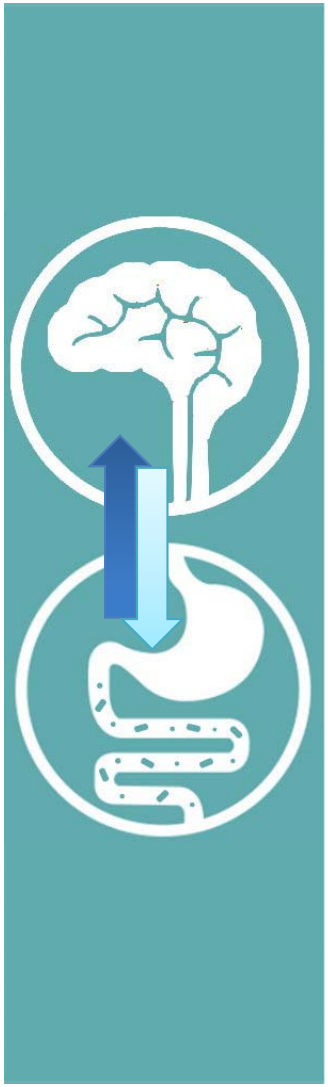
Use gut microbiota to treat neurological and emotional disorders



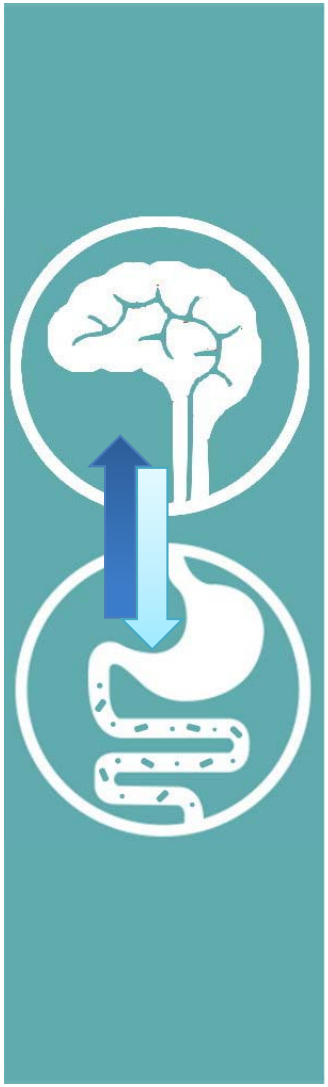
(By Kendra Lechtenberg)



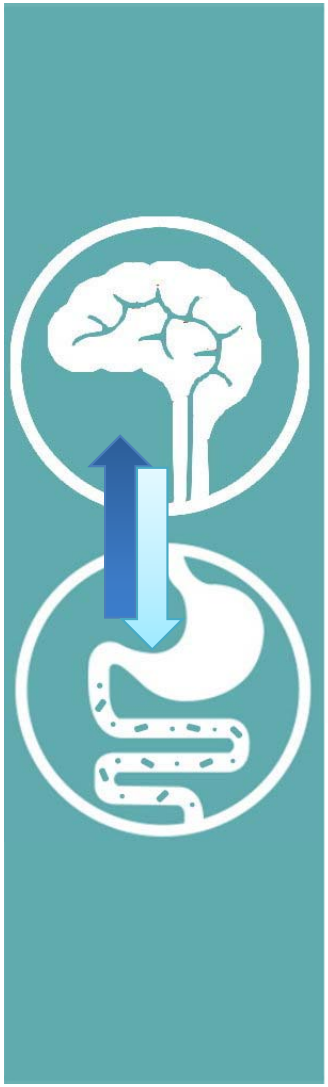
The End



Q & A



References



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