



Epigenetic Embedding of Early Life Experiences

How Environments Influence Health and Disease

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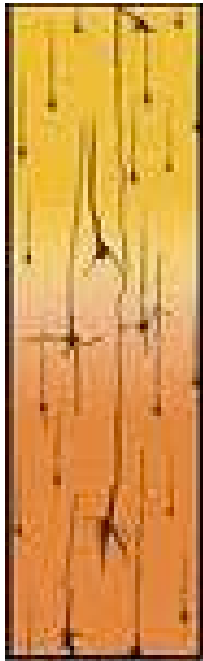
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University of British Columbia

CMMT
Centre for Molecular Medicine
and Therapeutics

**HUMAN
EARLY LEARNING
PARTNERSHIP**

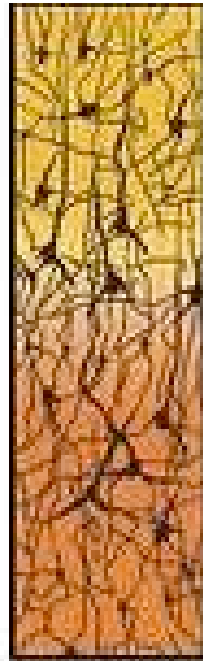
Sensitivity of the Developing Brain – Years of Wonder



Newborn



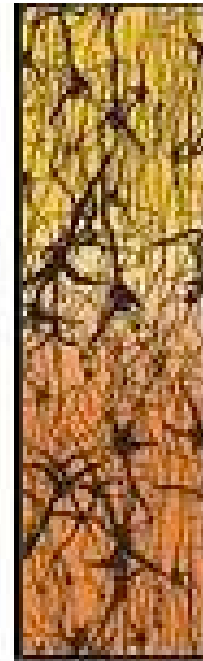
1 Month



9 Months



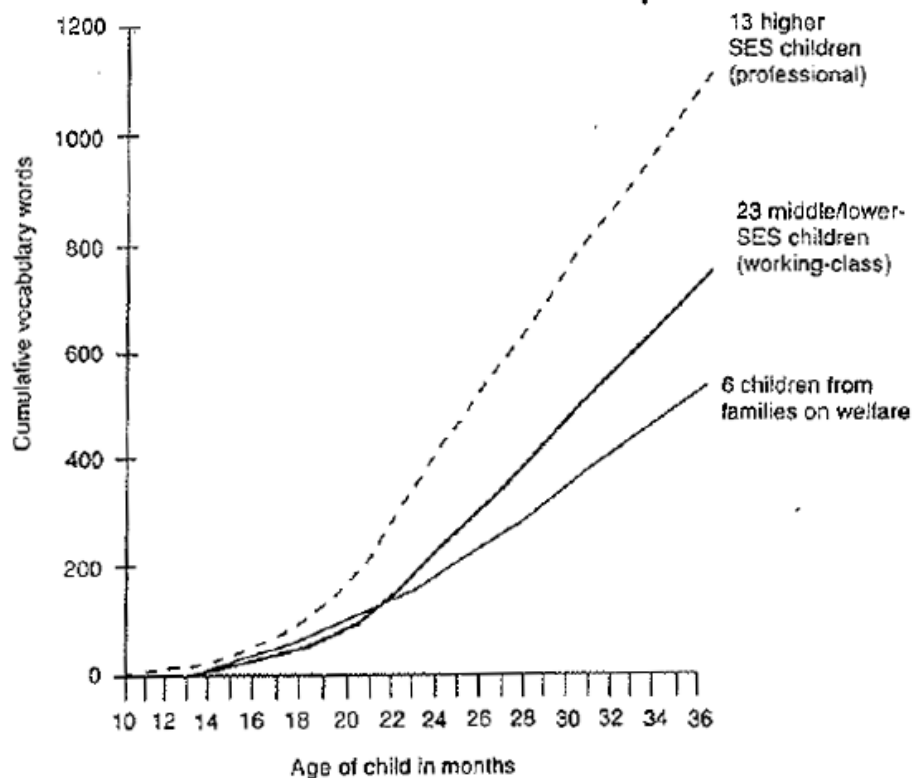
2 Years



Adult

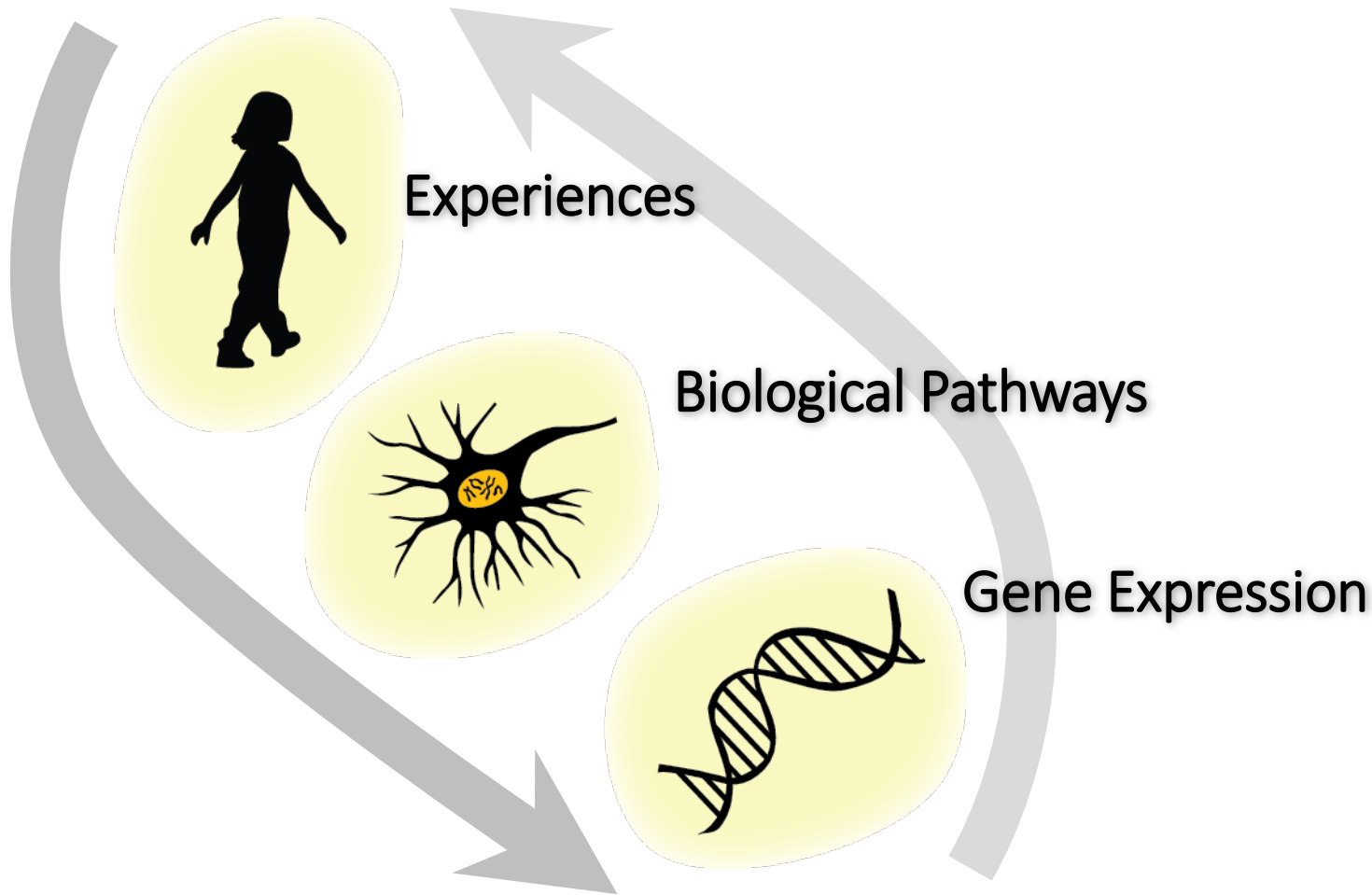
Brain Development in Children

- In the 1st years of life the brain grows at the pace of 700 new neural connections per second, a pace which is never achieved again.
- By 3 years of age, a child brain is twice as active as an adult brain.
- It is early life experiences that determine the capacity of the brain.

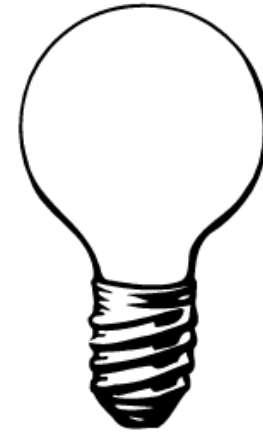
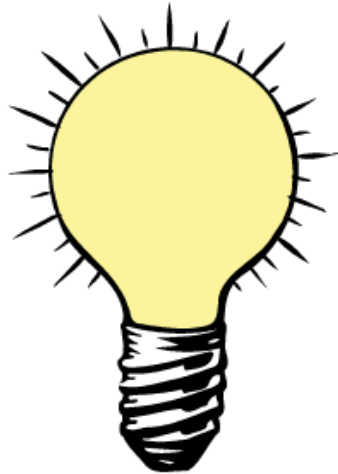


Epigenetics

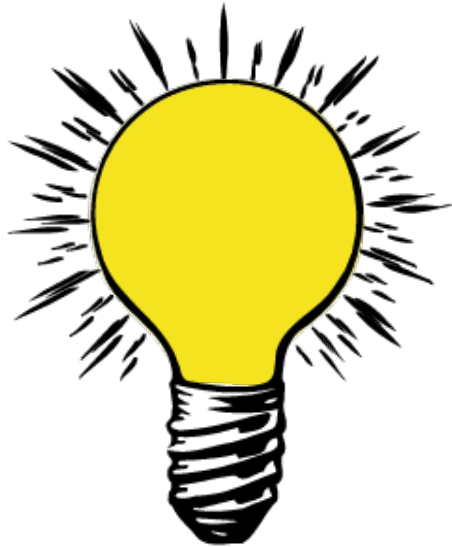
the processes by which life experiences influence the way in which genes are expressed. changes in DNA sequence.



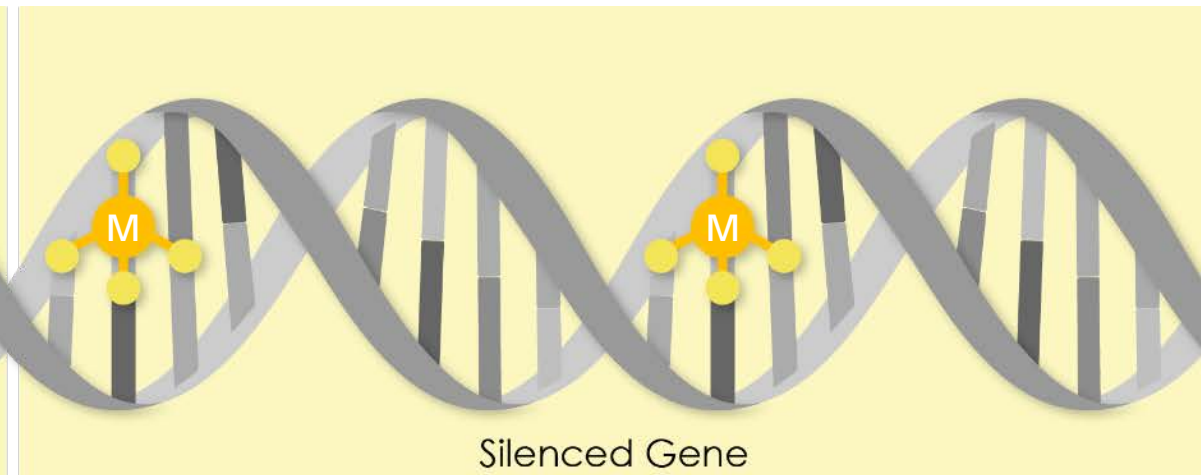
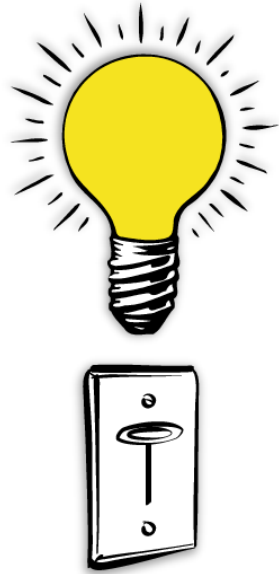
The Epigenome – Regulating Gene Activity



DNA Methylation



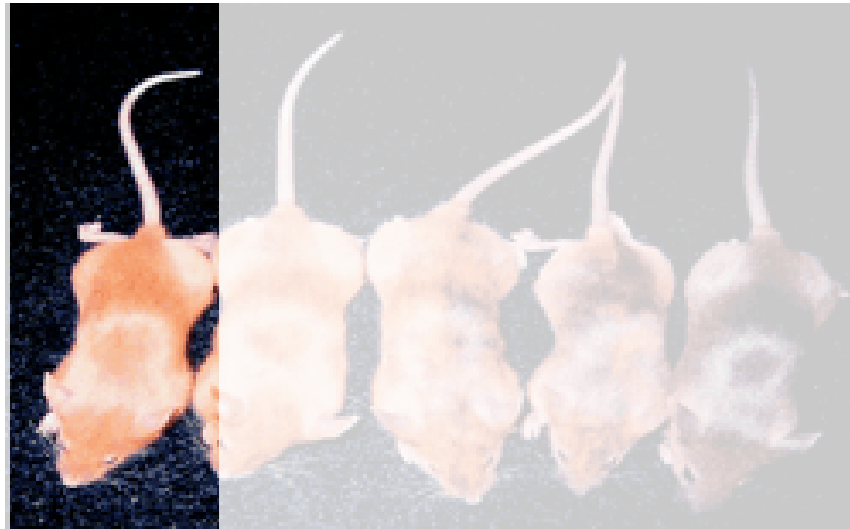
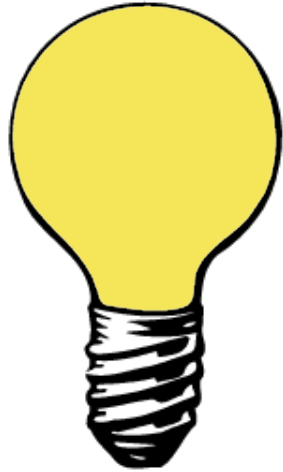
DNA Methylation



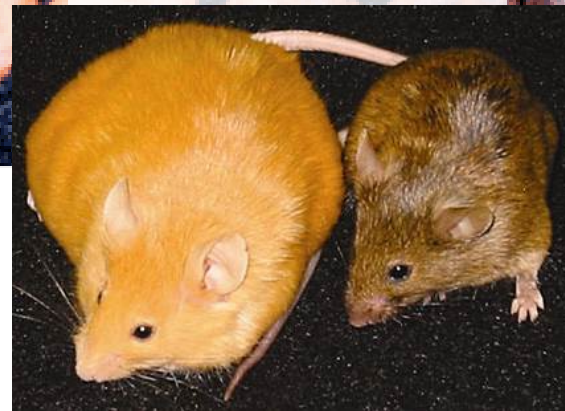
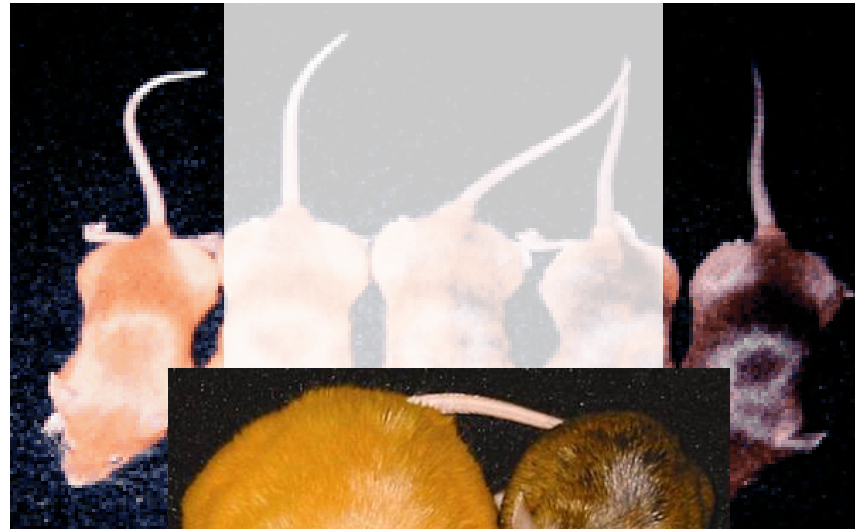
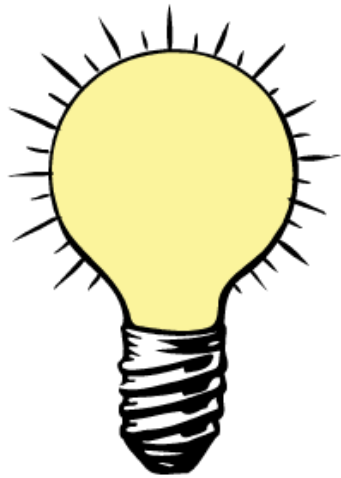
The Impact of Epigenetics on Health and Disease



Maternal Diet Affects Epigenetic Gene Regulation in Offspring



Maternal Diet Affects Epigenetic Gene Regulation in Offspring



Nutrition and lifestyle of the mother affects epigenome of the child



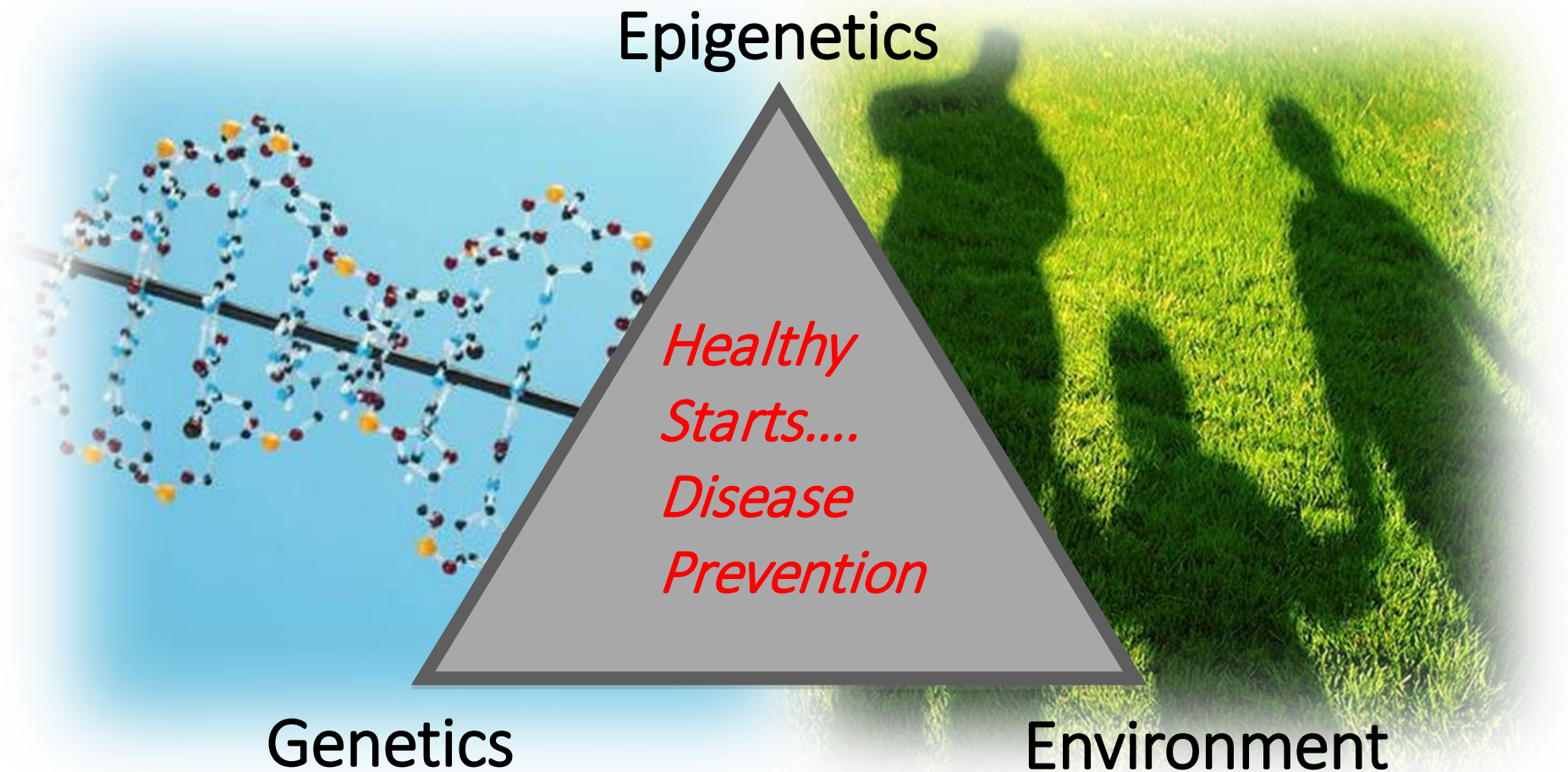
Maternal care affects epigenome of child



Identical twins acquire discordant epigenomes during life-course



Integrative Model of Epigenetics



Early Life Experiences Getting Under the Skin

Early Life Socio-Economic Status



Early Life Parental Stress



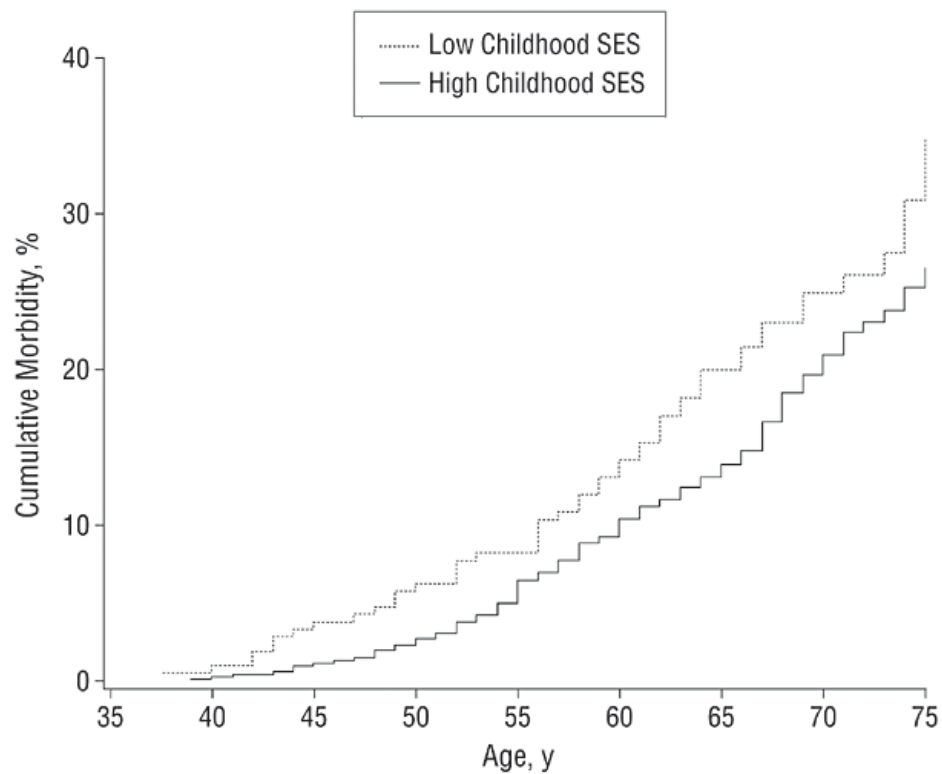
Childhood Temperament, Behavior and Trajectories



Gregory Miller, Edith Chen (Psychology, Northwestern)
W. Thomas Boyce (Human Early Learning Partnership, UBC)
Clyde Hertzman (Human Early Learning Partnership, UBC)
Marilyn Essex (University of Wisconsin)

Experiences Do Get Under the Skin...

Cumulative probability of coronary heart disease in 1131 white male medical school graduates according to childhood socioeconomic status (SES)



Early Life Socio-Economic Status

...but how?

Biological Residue of Low Early-Life Social Class



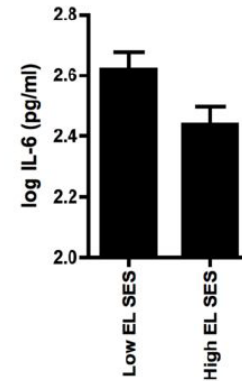
Childhood

Low SES
 Low SES
 High SES
 High SES

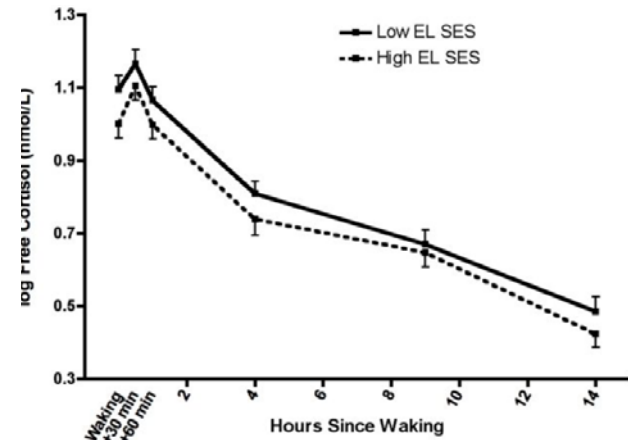
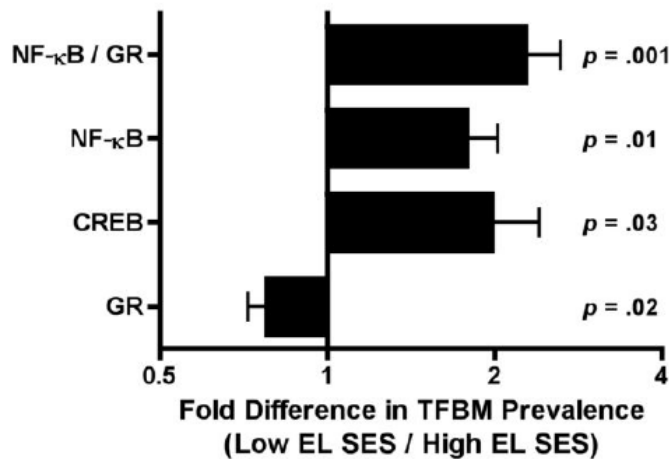
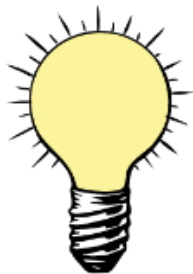
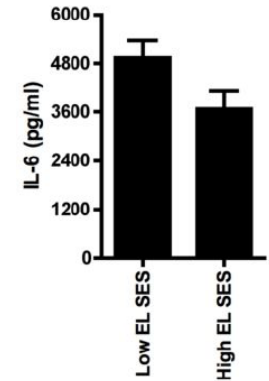
Adulthood

Low SES
 High SES
 Low SES
 High SES

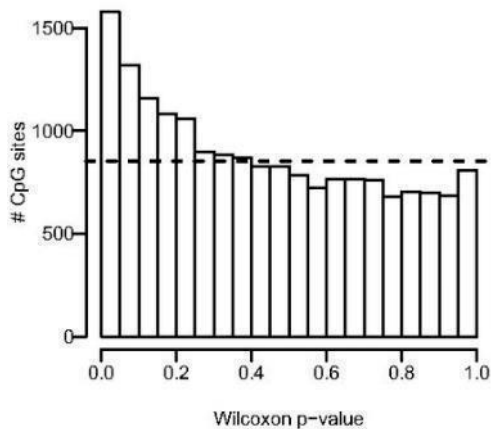
(a) TLR3 Stimulation by Poly I:C



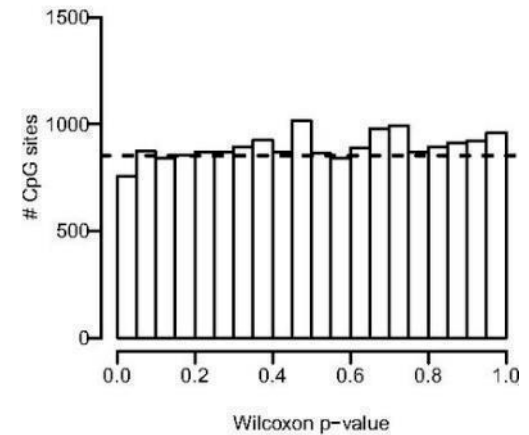
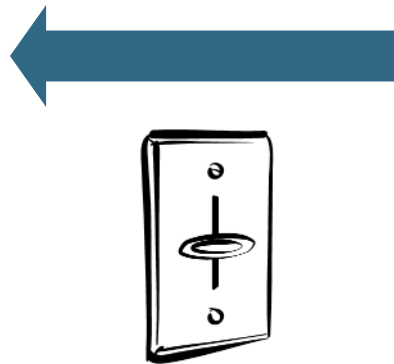
(b) TLR5 Stimulation by Flagellin



DNA Methylation Correlated with Early Life Socio-Economic Status



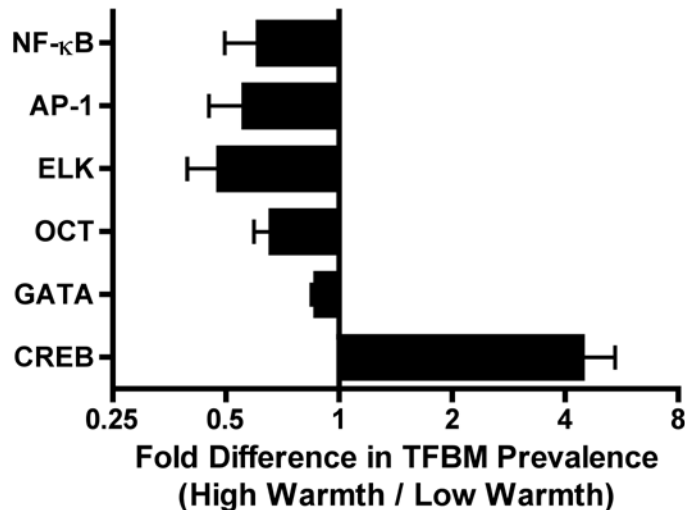
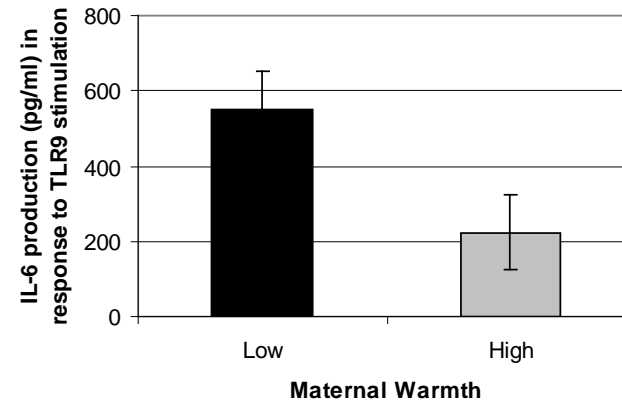
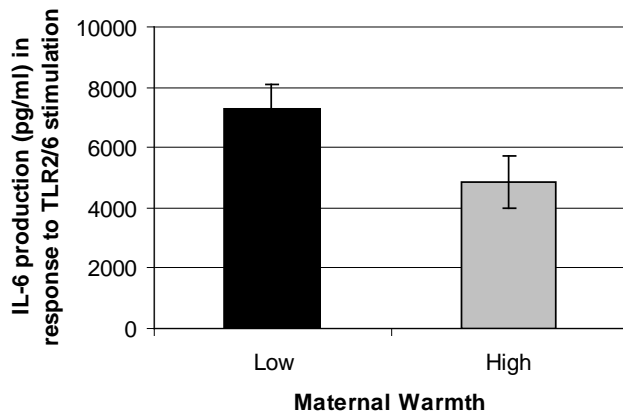
**Early Life SES
(Age 1-5)**



**Current SES
(Age 30-40)**



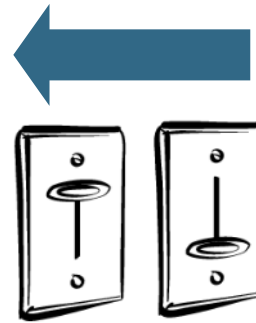
Maternal Warmth and Resilience to Low Early-Life SES Effects



Choose your parents wisely....

Epigenetic Vestiges of Early Parental Stress

Wisconsin Study of Families and Work (Longitudinal Birth Cohort)



HCS: FDR <5%
MCS: FDR 5%-20%

Full Group
(n=109)

Girls
(n=60)

Boys
(n=49)

Infancy

Maternal Stress

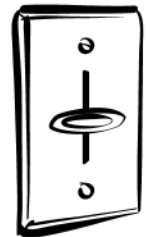
Paternal Stress

139 HCS

1 HCS

3 HCS

3 HCS



Summary

Epigenetics as an Integral Component of Human Health and Disease

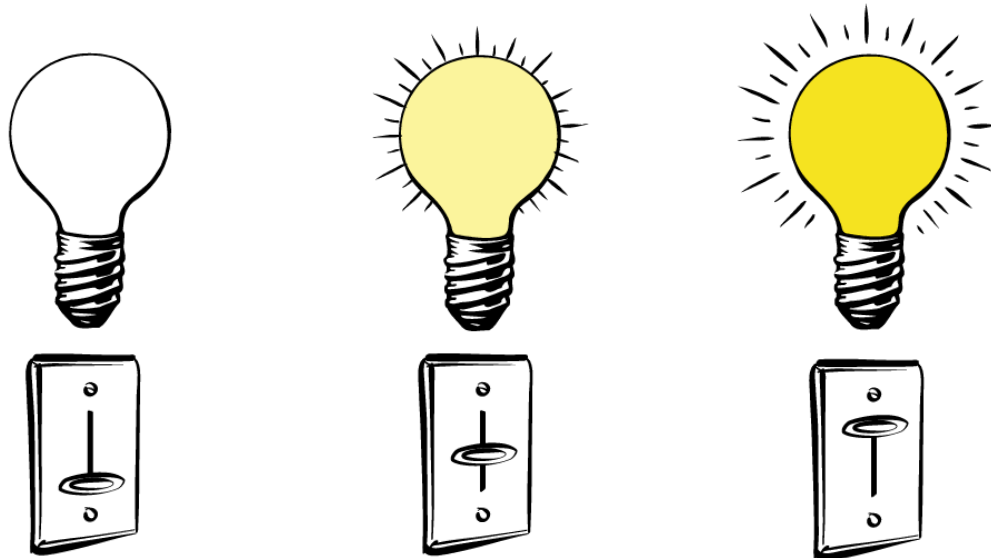
Genomic Embedding of Early Life Experiences

Biological Residue of Early Life Poverty

DNA Methylation Associated with Early Life Parental Stress

Childhood Temperament is Correlated with DNA Methylation

**Biology of Early Life Experiences and Mechanisms of Epigenetic Embedding:
Provide Healthy Starts to Prevent Disease and Design Targeted Interventions**



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University of British Columbia / Northwestern University

Greg Miller

University of British Columbia / Northwestern University

W. Thomas Boyce

University of British Columbia

Clyde Hertzman

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Nature vs.
Nurture?

Or both?