Healthy Lifestyle | Healthy Sperm | Healthy Children

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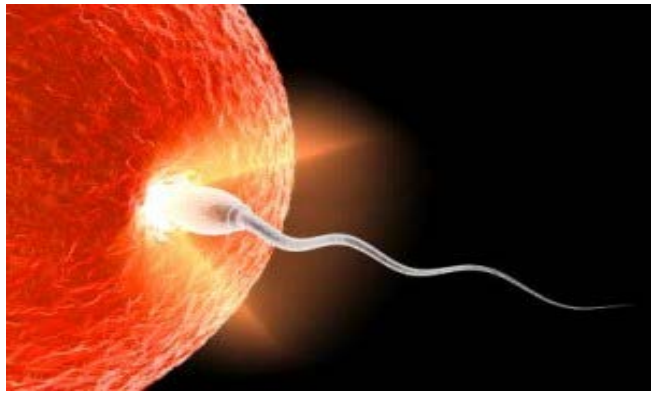
Structure of the Workshop

1. Four sessions with each lasting no more than 15 minutes
    I. Story telling with real life examples for all major concepts
    II. Use lay language as much as possible

2. Two experiments:
    I. Compare mouse and human sperm
    II. Sperm motility activation

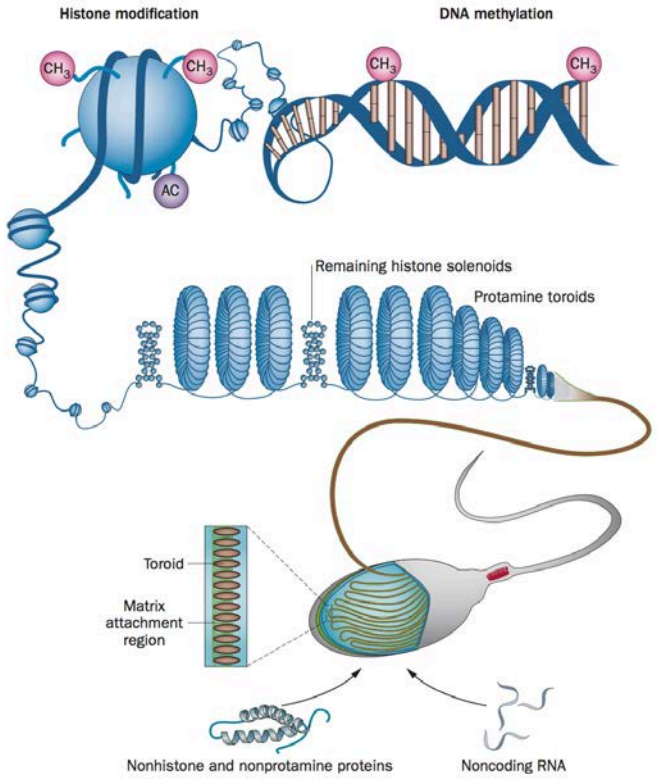
3. Q&A session

Where do we come from?



- How are sperm formed?
- How are eggs/oocytes formed?
- Fertilization: Fusion of a sperm and an egg/oocyte
- Embryonic development

What is inside sperm?



Genetic materials:

- DNA: double helix, large molecules
- Genetic code: combinations of four bases (A,C,T and G)

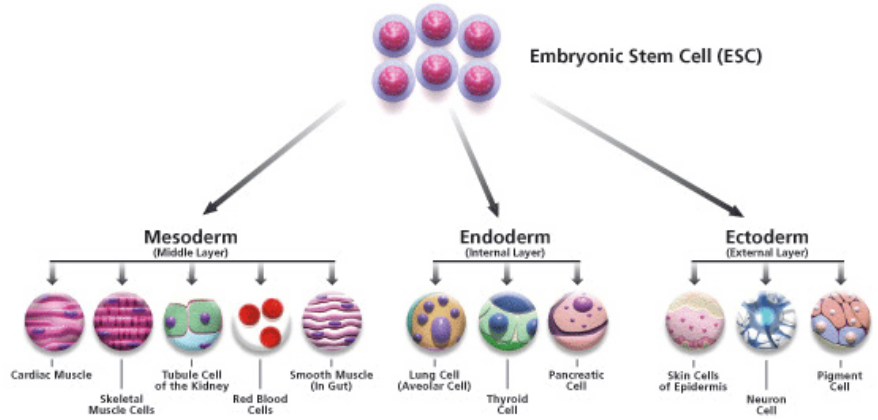
Epigenetic information:

- Chemically modified DNA: DNA methylation
- Chemically modified proteins: histone marks
- RNAs: large or small; coding or noncoding
- Chemically modified RNAs: m6A

Role of genetic materials in sperm

- Embryonic development
- Fetal development
- Preputerbal development
- Puberty
- Adult life

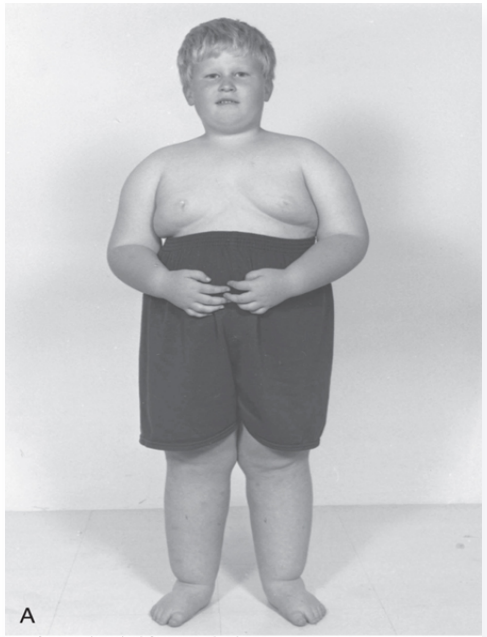
Epigenetic information within sperm



- Software (epigenetics) for the hardware/computer (genetics)
- Adaptive and responsive to environment, diet, physical activities
- Acquired traits: good vs. bad
- Inheritable or not?

Consequences of genetic defects

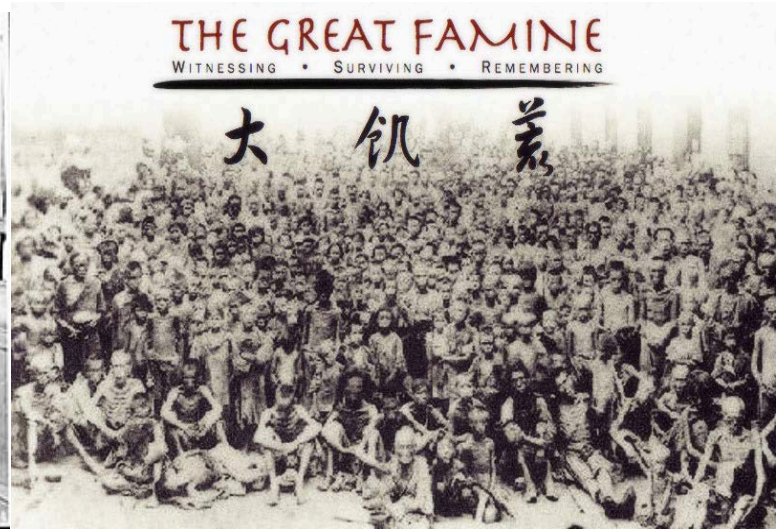
Prader-Willi Syndrome



Angelman Syndrome

- Infertility
- Abortion
- Birth defects
- Congenital diseases
- Single vs. multiple genetic defects

Effects of epigenetic alterations



- Disease tendency
- Latent/Adult onset
- Intergenerational vs. transgenerational inheritance

Acquired Paternal Traits in Offspring

nature neuroscience

Parental olfactory experience influences behavior and neural structure in subsequent generations

Brian G Dias[1,2] & Kerry J Ressler[1–3]

Using olfactory molecular specificity, we examined the inheritance of parental traumatic exposure, a phenomenon that has been frequently observed, but not understood. We subjected F0 mice to odor fear conditioning before conception and found that subsequently conceived F1 and F2 generations had an increased behavioral sensitivity to the F0-conditioned odor, but not to other odors. When an odor (acetophenone) that activates a known odorant receptor (*Olfr151*) was used to condition F0 mice, the behavioral sensitivity of the F1 and F2 generations to acetophenone was complemented by an enhanced neuroanatomical representation of the *Olfr151* pathway. Bisulfite sequencing of sperm DNA from conditioned F0 males and F1 naive offspring revealed CpG hypomethylation in the *Olfr151* gene. In addition, *in vitro* fertilization, F2 inheritance and cross-fostering revealed that these transgenerational effects are inherited via parental gametes. Our findings provide a framework for addressing how environmental information may be inherited transgenerationally at behavioral, neuroanatomical and epigenetic levels.

ARTICLES

nature medicine

Multigenerational epigenetic adaptation of the hepatic wound-healing response

Müjdat Zeybel[1], Timothy Hardy[1], Yi K Wong[2], John C Mathers[2], Christopher R Fox[1], Agata Gackowska[1], Fiona Oakley[1], Alastair D Burt[1], Caroline L Wilson[1], Quentin M Anstee[1], Matt J Barter[1], Steven Masson[1], Ahmed M Elsharkawy[1], Derek A Mann[1,3] & Jelena Mann[1,3]

Sciencexpress Research Articles

Disruption of histone methylation in developing sperm impairs offspring health transgenerationally

Keith Siklenka,[1*] Serap Erkek,[2,3*†] Maren Godmann,[4‡] Romain Lambrot,[4] Serge McGraw,[4] Christine Lafleur,[4] Tamara Cohen,[4] Jianguo Xia,[4,5] Matthew Suderman,[6] Michael Hallett,[6] Jacquetta Trasler,[2,4] Antoine H. F. M. Peters,[2,3*§] Sarah Kimmins[1,4*§]

tional epigenetic inheritance (Fig. 1). Maternal and paternal transmission of such effects has been related to alterations of DNA methylation in germ cells (*7, 9–11*). DNA methylation occurs at the 5-position of cytosine residues and associates with heritable gene silencing when promoter sequences containing multiple CpG dinucleotides (CpG islands; CGIs) are methylated. Likewise, DNA methylation sup-

nature genetics

Epigenetic germline inheritance of diet-induced obesity and insulin resistance

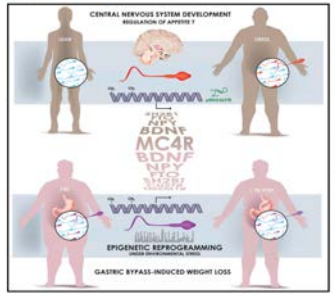
Peter Huypens[1–3], Steffen Sass[4], Moya Wu[1,2], Daniela Dyckhoff[1–3], Matthias Tschöp[3,5,6], Fabian Theis[4,7], Susan Marschall[1,2], Martin Hrabě de Angelis[1–3,8,9] & Johannes Beckers[1–3,8,9]

Short Article

Cell Metabolism

Obesity and Bariatric Surgery Drive Epigenetic Variation of Spermatozoa in Humans

Graphical Abstract



Authors

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In Brief

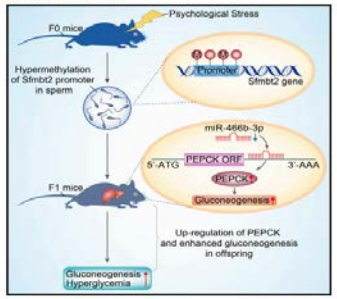
Donkin et al. show that spermatozoa from obese men carry a distinct epigenetic signature compared to lean men, in particular at genes controlling brain development and function. The sperm methylome is dynamically remodeled after gastric-bypass-induced weight loss, notably at gene regions implicated in the central control of appetite.

Short Article

Cell Metabolism

Paternal Psychological Stress Reprograms Hepatic Gluconeogenesis in Offspring

Graphical Abstract



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Ling Wu, Yan Lu, Yang Jiao, ..., Jieli Lu, Xuejin Chen, Xiaoying Li

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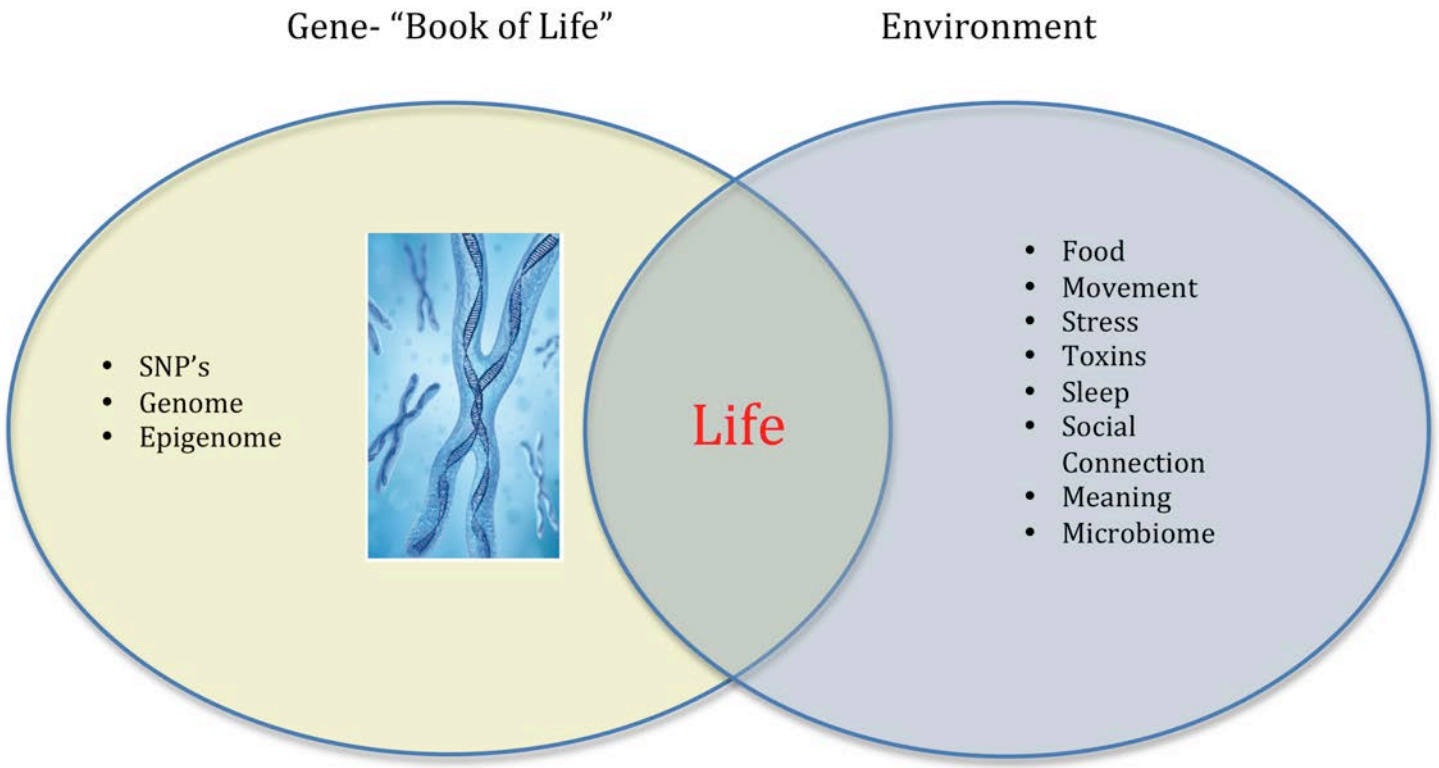
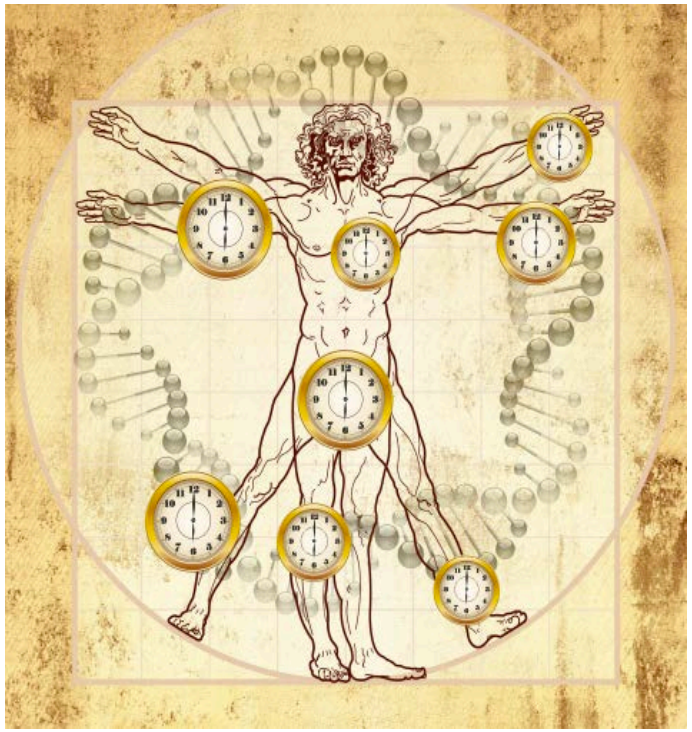
In Brief

Using a mouse model of restraint stress, Wu et al. uncover the intergenerational effects of paternal psychological stress on glucose metabolism in offspring. Paternal stress epigenetically downregulates miR-466b-3p expression, leading to increased PEPCK expression and hepatic gluconeogenesis in hyperglycemic F1 mice.

Our genome constantly interacts with environments



“Growth ring” in humans
-Aging and the methylome



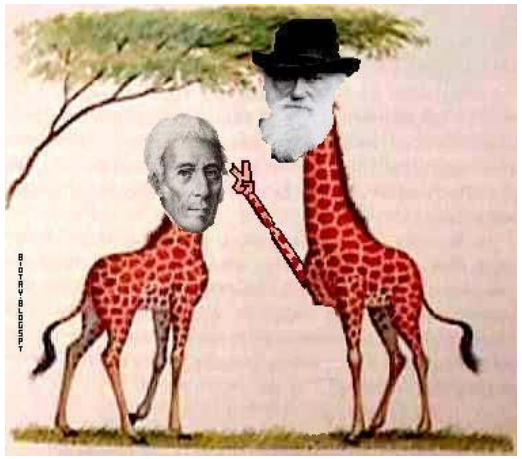
Representative Clinical Conditions with Epigenetic Origins

- Type 2 DM and Metabolic Syndrome
- Coronary artery disease
- Autoimmune Diseases
- Cancer
- Allergic Disorders
- Depression
- Neurologic: Alzheimer's, PD, ALS, Autism
- Infertility

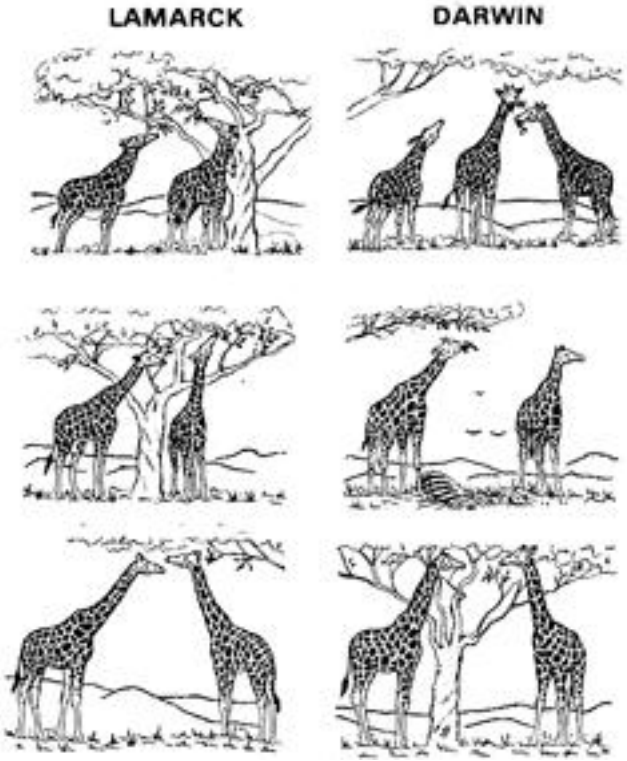
Lifestyle/Behavioral Factors Shown to Have Health-Promoting Epigenomic Influences

- Plant-based, unprocessed foods
- Movement
- Mindfulness
- Bonding-social connection
- Reduction in environmental toxin exposure
- Microbiome

Evolution Theories



Lamarck	Darwin
Use and disuse	Variation
Transmission of acquired characteristics	Inheritance
Increasing complexity	Differential survival
No extinction	Extinction



http://www.scienzainrete.it/files/u/girafas-de-lamarck.jpg

Thank You!