
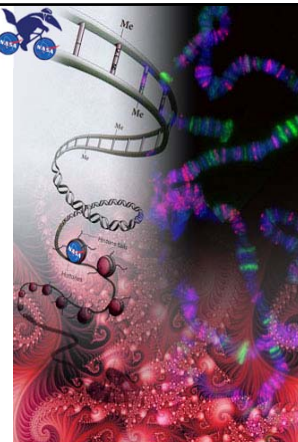


The Promise of Genomics and Epigenetics Studies In NASA Exercise Research

Shlomit Radom-Aizik PhD
Director, Pediatric Exercise and Genomics
Research Center (PERC)

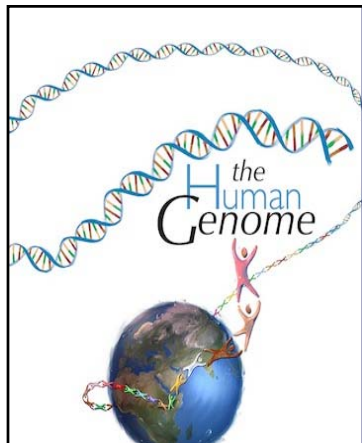

PERC
UC Irvine
UC Irvine Health
School of Medicine



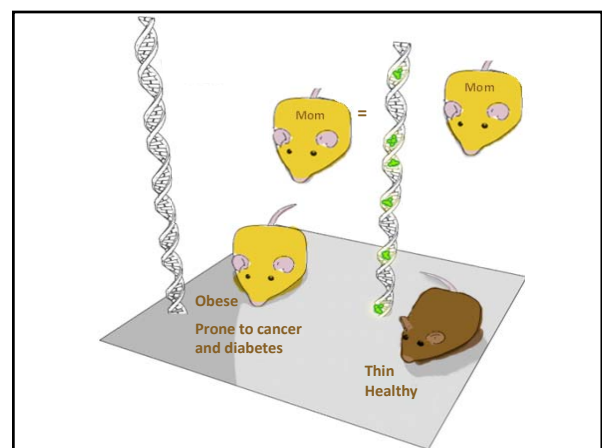
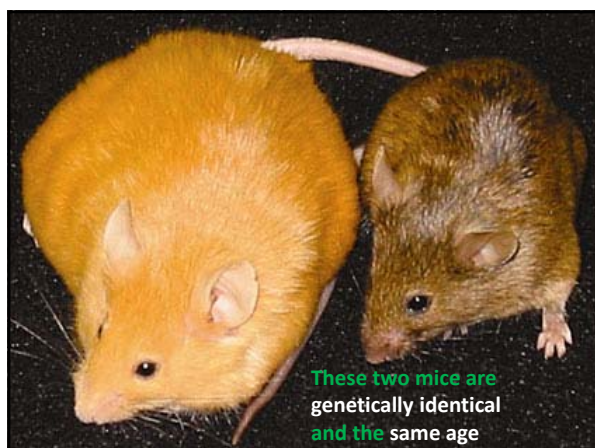
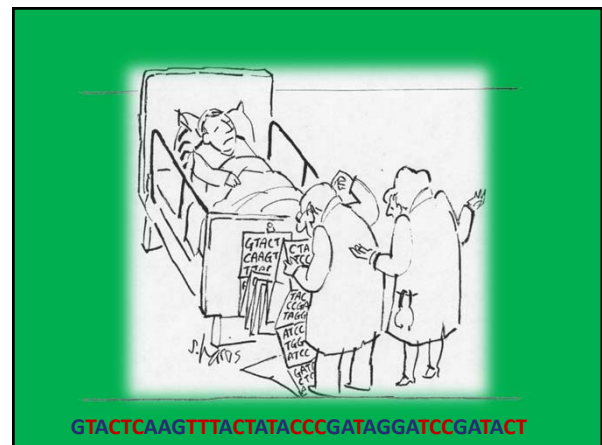
Goals for Today's Talk

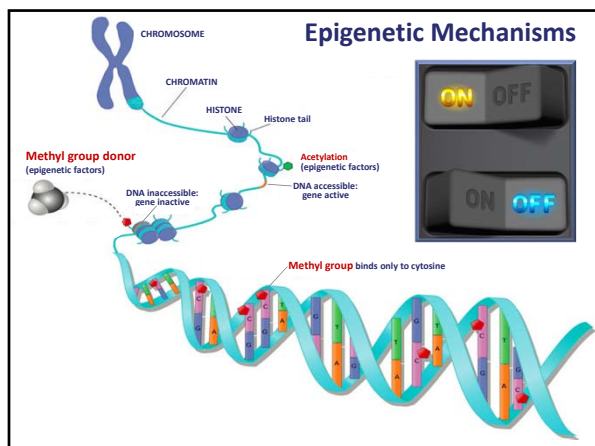


- Genomics and Epigenetics
relevant concepts in the evolving field
- MoTrPAC; new NIH initiative and its connection
to NASA exercise research
- Current genomic and epigenetic studies in NASA
exercise research



13 Years
\$ 3 Billion
~ 48 Hours
~ \$ 2000

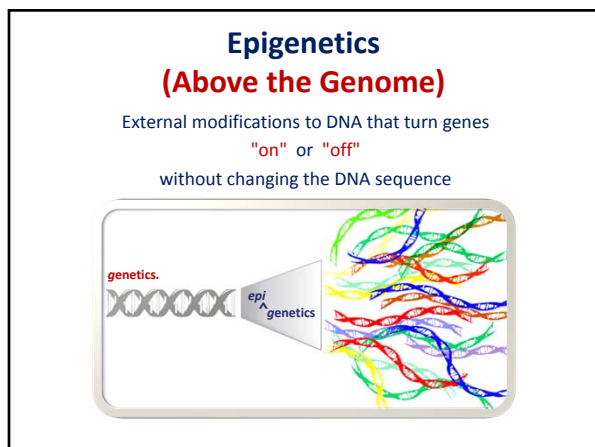




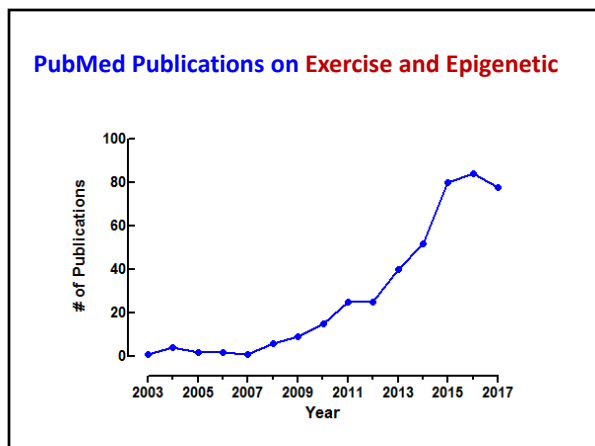
letseatgrandma

Lets eat, grandma!

Lets eat grandma!



A whole range of
environmental and lifestyle
 factors can trigger the
 "on/off switches" in our
 genes – factors like diet,
 stress, drugs, pollution
MICROGRAVITY and
EXERCISE



Dr. Francis Collins, Director, National Institutes of Health talks about how the **Molecular Transducers of Physical Activity Consortium (MoTrPAC)** will allow researchers to develop a comprehensive map of the molecular changes that occur in response to physical activity.





**NIH common fund groundbreaking
exercise trial to create the molecular map
in response to exercise**



The Molecular Transducers of Physical Activity Consortium
consists of 19 awards for research at 23 institutions



**Molecular Transducers of Physical Activity
Consortium (MoTrPAC)**

Why now?

- Technology
- Databases-Big data

Long term goals:

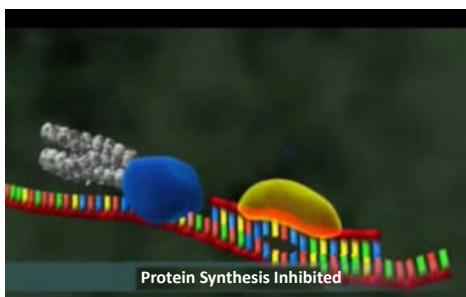
- Personalized exercise prescription
- Exercise medicine

By generating a **comprehensive map of molecular responses** to physical activity, MoTrPAC will lay the foundation for a new era of biomedical research on **Precision Exercise Medicine**.

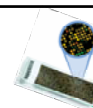
**Current Genomic and Epigenetic Studies in
NASA Exercise Research**



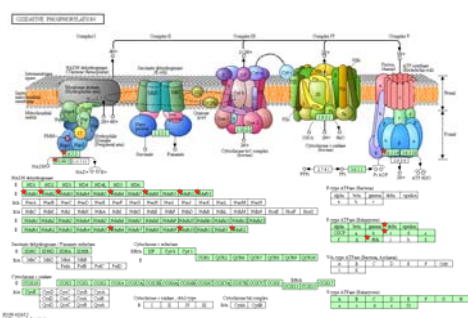
Genomic and epigenetic modifications during 70-day bed rest with and without countermeasures to mitigate the negative consequences of weightlessness



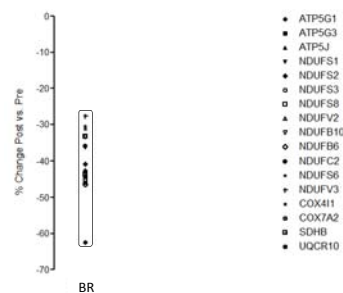
Study Design



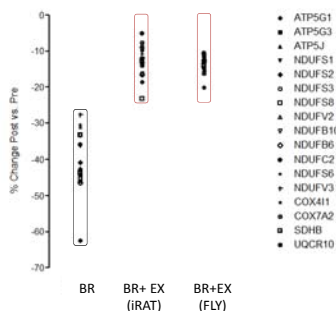
17 Oxidative Phosphorylation Pathway genes were down regulated in response to Bed Rest



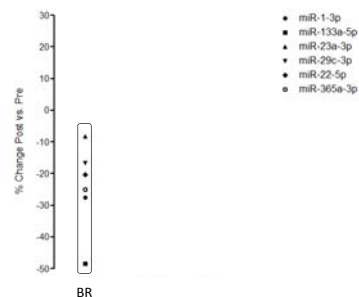
17 Oxidative Phosphorylation Pathway genes were down regulated in response to Bed Rest (2)



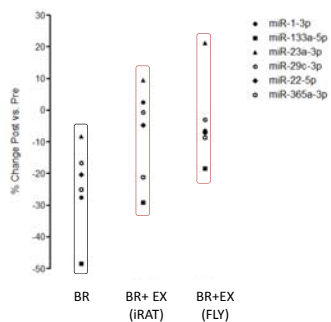
Exercise Training Attenuates the Muscle Gene Expression Response to Bed Rest



Selected MicroRNAs Down-Regulated in Bed Rest



Exercise Training Attenuates the Muscle MicroRNA Response to Bed Rest



Distinct DNA Methylation Response to Different Training Programs



Study Design

32 subjects (20-26 y/o, 15 females)
5 week exercise protocol

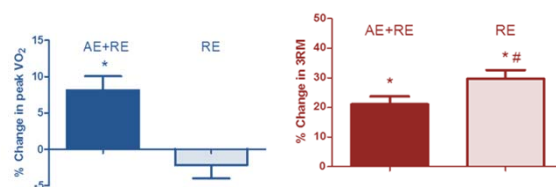
Combined Aerobic (AE) & Resistance (RE),
5 days a week: 3 days of AE 2 days of RE



Resistance Exercise (RE)
2 days a week



Five weeks of training increased peak VO_2 only in the AE+RE, while leg press strength was significantly improved in both groups but to a greater extent in the RE group



Five Weeks of Exercise Altered DNA Methylation

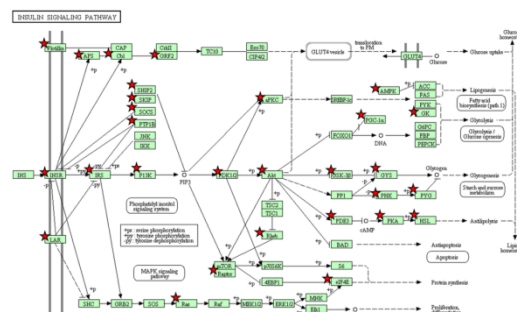
2541 (AE+RE) vs. 229 (RE) genes were altered, $p < 0.0005$ (75 common).

42 KEGG Pathways



2541 genes (AE+RE)

Insulin Signaling Pathway



Mapping the **genomic responses** to exercise in altered gravity conditions, will allow us to develop **Precision Exercise-Medicine Programs** to be used in space and maintain our astronauts health



Acknowledgments

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Pediatric Exercise and Genomics Research Center (PERC)

