

## Metabolism – Fact vs Fiction

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GARAGE GIRLS FITNESS

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## Objectives

- Participants will be able to explain the components of metabolism.
- Participants will gain an understanding of the energy balance equation.
- Participants will be able to describe the metabolic variances among individuals.
- Participants will be able to explain the genetic contribution to metabolism.
- Participants will be able to identify hormones associated with metabolism.

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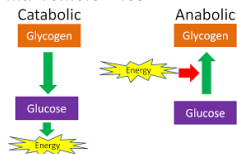
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## What is Metabolism?

Metabolism is the body's ability to utilize for essential biomolecules or macromolecules



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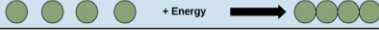
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## Anabolic Pathways

### Metabolic pathways

**Anabolic:** Small molecules are assembled into large ones. *Energy is required.*



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## Catabolic Pathways

**Catabolic:** Large molecules are broken down into small ones. *Energy is released.*



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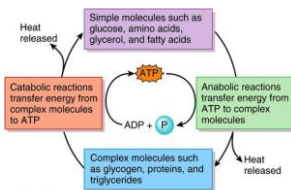
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## Catabolism Fuels Anabolism



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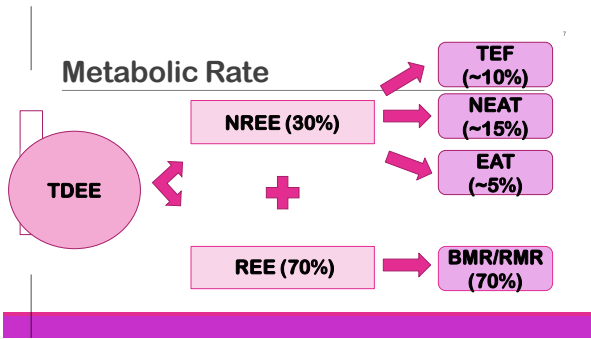
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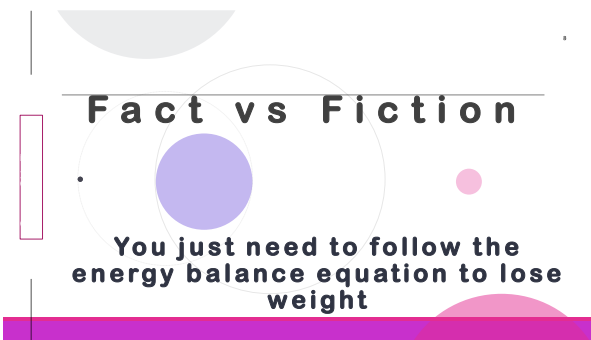
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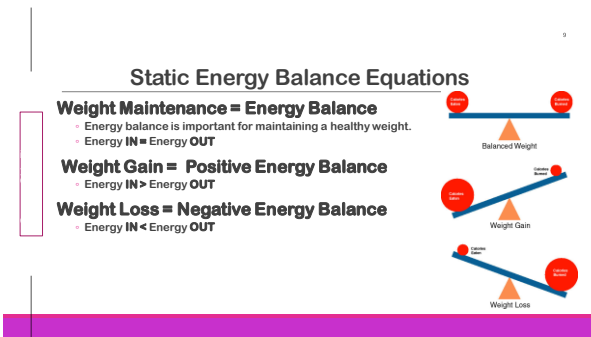
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### 3,500-kcal Rule



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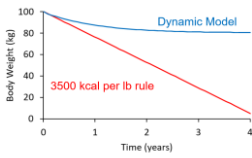
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### Dynamic Energy Balance Equation

Corrected Weight Loss Projections



KD Hill et al. The Lancet 379:826-37 (2011)

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### Fact vs Fiction

I have a low metabolic rate

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## RMR Differences



0.892 kcal·kg<sup>-1</sup>·h<sup>-1</sup>

0.839 kcal·kg<sup>-1</sup>·h<sup>-1</sup>

0.926 kcal·kg<sup>-1</sup>·h<sup>-1</sup>

0.721 kcal·kg<sup>-1</sup>·h<sup>-1</sup>



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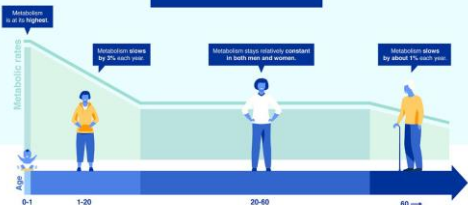
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## 4 Phases of Metabolism



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## Fact vs Fiction

It's in my genes!

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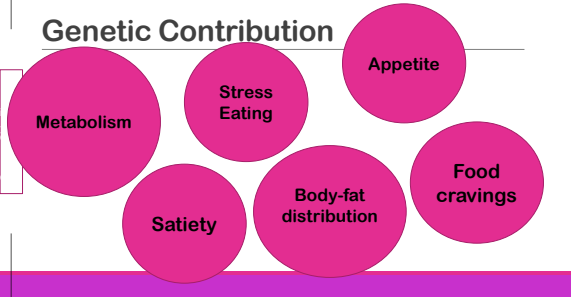
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## Genetic Contribution




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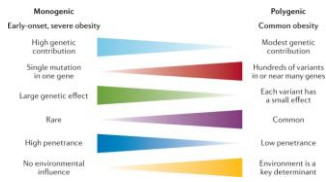
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## Monogenic vs Polygenic




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## Categories for Genes

Regulation of food intake by molecular signaling in the hypothalamus and hindbrain by signals originating in adipose tissue, gut and other organs

Regulation of adipocyte differentiation and fat storage

Regulation of spontaneous exercise activity

Effect on basal and postprandial thermogenesis

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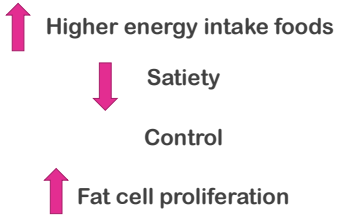
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## FTO Gene




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## Selected Genes Associated with Obesity

Gene symbol	Gene name	Gene product's role in energy balance
ADIPOQ	Adipocyte, C1q-, and collagen domain-containing	Produced by fat cells, adiponectin promotes energy expenditure
FTO	Fat mass- and obesity-associated gene	Promotes food intake
LEP	Leptin	Produced by fat cells
LEPR	Leptin receptor	When bound by leptin, inhibits appetite
INSIG2	Insulin-induced gene 2	Regulation of cholesterol and fatty acid synthesis
MCR4	Melanocortin 4 receptor	When bound by alpha-melanocyte stimulating hormone, stimulates appetite
PCSK1	Proprotein convertase subtilisin/kexin type 1	Regulates insulin biosynthesis
PPARG	Peroxisome proliferator-activated receptor gamma	Stimulates lipid uptake and development of fat tissue

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## Strong Contribution

Overweight for much of life.

One or both of parents or several other blood relatives are significantly overweight.

Can't lose weight even when there is an increase physical activity and stick to a low-calorie diet for many months.

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### Low Contribution

Strongly influenced by the availability of food.

Moderately overweight, but can lose weight when a reasonable diet and exercise program is followed.

Regain lost weight during the holiday season, after changing eating or exercise habits, or when psychological or social problems are experienced.

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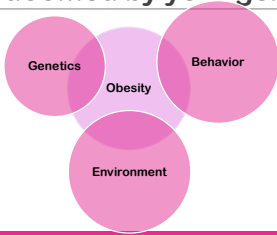
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### Are you doomed by your genes?



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### Environmental Issues



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## Fact vs Fiction

Hormones are wreaking havoc on my weight!

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### Anabolic Hormones

- Growth Hormone
- Insulin
- Estrogen
- Testosterone



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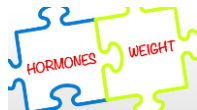
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### Catabolic Hormones

- Adrenaline or epinephrine
- Cortisol
- Glucagon
- Cytokines



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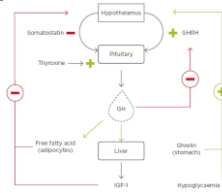
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## Growth Hormone

Suppresses glucose uptake and glucose oxidation, and stimulates gluconeogenesis, glycogenesis, and lipolysis

↓ Age  
 ↓ Lean body mass  
 ↑ Body Fat



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## GH Production Regulation



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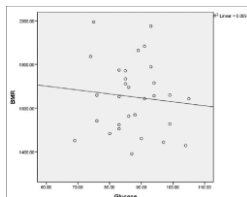
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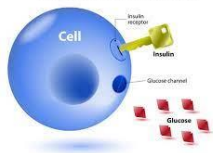
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## Insulin



IMPORTANCE OF INSULIN



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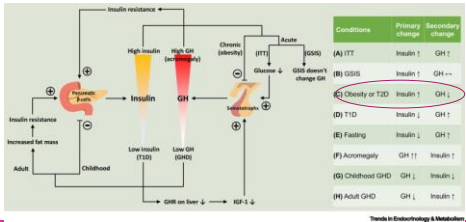
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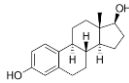
## Growth Hormone x Insulin



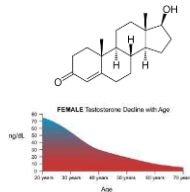
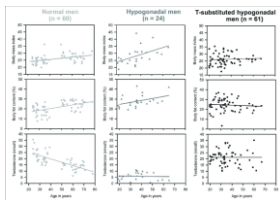
## Estrogen

Produced in ovaries, adrenal gland, and adipose tissue

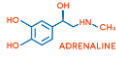
↓ May reduce metabolic rate



## Testosterone



# Epinephrine



Fight or flight



Temporary hold on eating

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# Cortisol



Cortisol - The Stress Hormone

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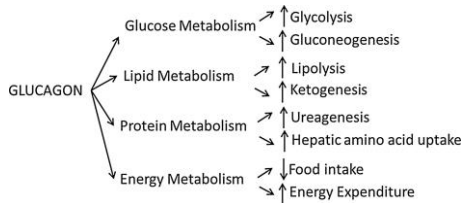
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# Glucagon




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# Cytokines

Cytokine	Effects on Metabolism
TNF- $\alpha$	Induces insulin resistance; increase glycolysis, adenosine triphosphate (ATP) production, and lactate export; reduce vitamin metabolism
IL-2	Increases glucose metabolism via Akt-mTOR signaling to promote T cell differentiation
IL-4	Up-regulates the expression of glucose transporter 4 (GLUT4); enhance glucose and lipid metabolism
IL-6	Reduces vitamin metabolism; enhance lipolysis
IL-10	Promotes insulin sensitivity; inhibits aerobic glycolysis and promotes oxidative phosphorylation
IFN $\gamma$	Induce fatty acid oxidation; reduce lipid biosynthesis

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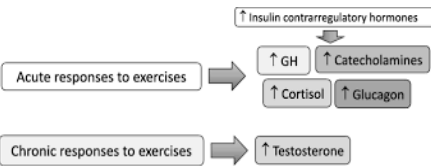
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# Fact vs Fiction

To increase my metabolic rate I need to resistance train

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### Does resistance training increase RMR?

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Effects on RMR  
Effects on TDEE

Increase in TDEE

Small changes in RMR **MAY** occur following a resistance training program

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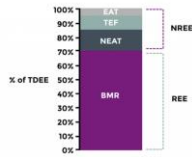
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### Bottom Line.....

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TDEE = Total Daily Energy Expenditure  
 REE = Resting Metabolic Rate  
 NREE = Non-Resting Metabolic Rate  
 EAT = Exercise Activity Thermogenesis  
 BMR = Basal Metabolic Rate  
 NEAT = Non-Exercise Activity Thermogenesis  
 TEF = Thermic Effect of Food

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Jan.Schroeder@csulb.edu

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