Body energy, Metabolic Rate, and Regulation of Food Intake
The Food Guide Pyramid, Fig# 25.18
Types of Work

**Chemical works**: building of cellular components, secretions, etc.

**Mechanical works**: muscle contractions, heart pumping, etc.

**Electrical works**: nerve conduction, resting potential (by maintaining the activity of Na+/K+ pumps and other pumps).
Figure 17.1 A metabolic map, indicating the reactions of intermediary metabolism and the enzymes that catalyze different chemical intermediates, or metabolites, and a greater number of enzymes are represented here.

(Courtesy of D. E. Nation, University of Leeds, U.K., and the Sigma Chemical Co.)
Muscle work and Energy

**Anaerobic**
- Muscle activity
  - ATP → ADP + P_i
- Carbohydrates
  - pyruvate/lactate

**Aerobic**
- Fat, carbohydrates and "branched-chain" Amino acids
  - CO_2 + H_2O
  - O_2
Respiratory Quotient = \frac{\text{volume of carbon dioxide per unit time}}{\text{volume of oxygen per unit time}}
Metabolic Rate

Measurements:
- Direct Calorimetry
- Indirect Calorimetry
  (O₂ consumption)
- Closed method
- Opened method
Spirometer (measurement of O₂ consumption)
Basal Metabolic Rate (BMR) measurement under basal conditions
Basal Conditions

- No eaten food for at least 12 hours.
- Measurement after a night of restful sleep.
- No exercise in the hour prior to the test.
Factors affecting metabolic rate

- **Exercise**: increases
- **Daily activities**
- **Age**: 
- **Sleep**: 
- **Climate**: 
- **Fever**: 
- **Malnutrition**;
- **Specific dynamic action**:
- **Effect of hormones**:
  - Thyroid hormones:
  - Male sex hormones increase 10-15%.
  - Growth hormones: Increase 15-20%
- **Effect of sympathetic stimulation**: increases metabolic rate.
Regulation of food intake
Food intake = Energy expenditure

Calories In

Energy Intake
"Calories in"

Weight Stable

Energy Expenditure
"Calories out"

Daily Activity Out
Positive balance

Energy Intake “Calories in”

Calories In

Weight Gain

Energy Expenditure “Calories out”

Daily Activity Out

Negative balance

Energy Intake “Calories in”

Calories In

Weight Loss

Energy Expenditure “Calories out”

Daily Activity Out
Food intake = Energy expenditure
Hypothalamic control of food intake

**Feeding center**: lateral nuclei.

**Satiety center**: ventromedial nuclei

**Amygdala** (destruction → psychic blindness).

**prefrontal cortex**:
Regulation of food intake

Long term regulations

Glucostatic theory of hunger and feeding regulation:

Lipostatic theory: Leptin

Aminostatic theory:

Body temperature and its relation to food intake: thermoregulatory and feeding centers

Psychosocial factors:
Leptin regulates energy expenditure and food intake in response to weight loss or gain.

- **Weight Loss**:
  - Leptin levels decrease.
  - Increased food intake.
  - Decreased energy expenditure.

- **Weight Gain**:
  - Leptin levels increase.
  - Decreased food intake.
  - Increased energy expenditure.
Regulation of food intake

Long term regulations

**Glucostatic** theory of hunger and feeding regulation:

**Lipostatic** theory: Leptin

**Aminostatic** theory:

Body temperature and its relation to food intake: **thermoregulatory and feeding centers**

Psychosocial factors:
Short term regulation of food intake

These are rapid signals that affect feeding.

Gastrointestinal filling:

Hormonal factors:

Suppression by oral receptors:
Obesity

- Calories In
- Energy Intake
  - "Calories in"

- Weight Gain

- Energy Expenditure
  - "Calories out"

- Daily Activity Out
OBESITY

Causes of obesity

Neurogenic abnormalities:
Genetic factors:
Psychosocial factor:
Childhood overnutrition:

Other causes of obesity:
Disorders of the endocrine system (hypothyroidism) and lack of physical exercise.
Inanition

Negative balance

Causes:
psychogenic (anorexia nervosa) or hypothalamic abnormalities
Starvation and depletion of stores in the body
GOOD LUCK

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