

# Body energy, Metabolic Rate, and Regulation of Food Intake



**FATS, OILS, & SWEETS  
USE SPARINGLY**

**Key:**

- Fat (naturally occurring and added)
- ▼ Sugars (added)

These symbols show fat and added sugars in foods. They come mostly from the fats, oils, and sweets group. But foods in other groups—such as cheese or ice cream from the milk group or french fries from the vegetable group—can also provide fat and added sugars.

**MILK, YOGURT, & CHEESE GROUP**

**Examples:**

- 1 cup milk or yogurt
- 1.5 oz natural cheese



2-3 servings



2-3 servings

**MEAT, POULTRY, FISH, DRY BEANS, EGGS,  
& NUTS GROUP**

**Examples:**

- 2-3 oz cooked, lean meat, chicken, or fish  
(Count 1/2 cup cooked dry beans, 1 egg, or, 2 tablespoons peanut butter as 1 oz lean meat)

**VEGETABLE GROUP**

**Examples:**

- 1 cup raw leafy vegetables
- 1/2 cup other vegetables
- 3/4 cup vegetable juice



3-5 servings

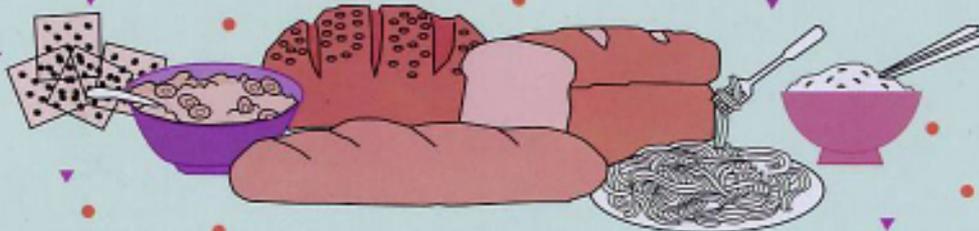


3-5 servings

**FRUIT GROUP**

**Examples:**

- 1 medium banana, apple, or orange
- 3/4 cup fruit juice
- 1 melon wedge
- 1/4 cup dried fruit



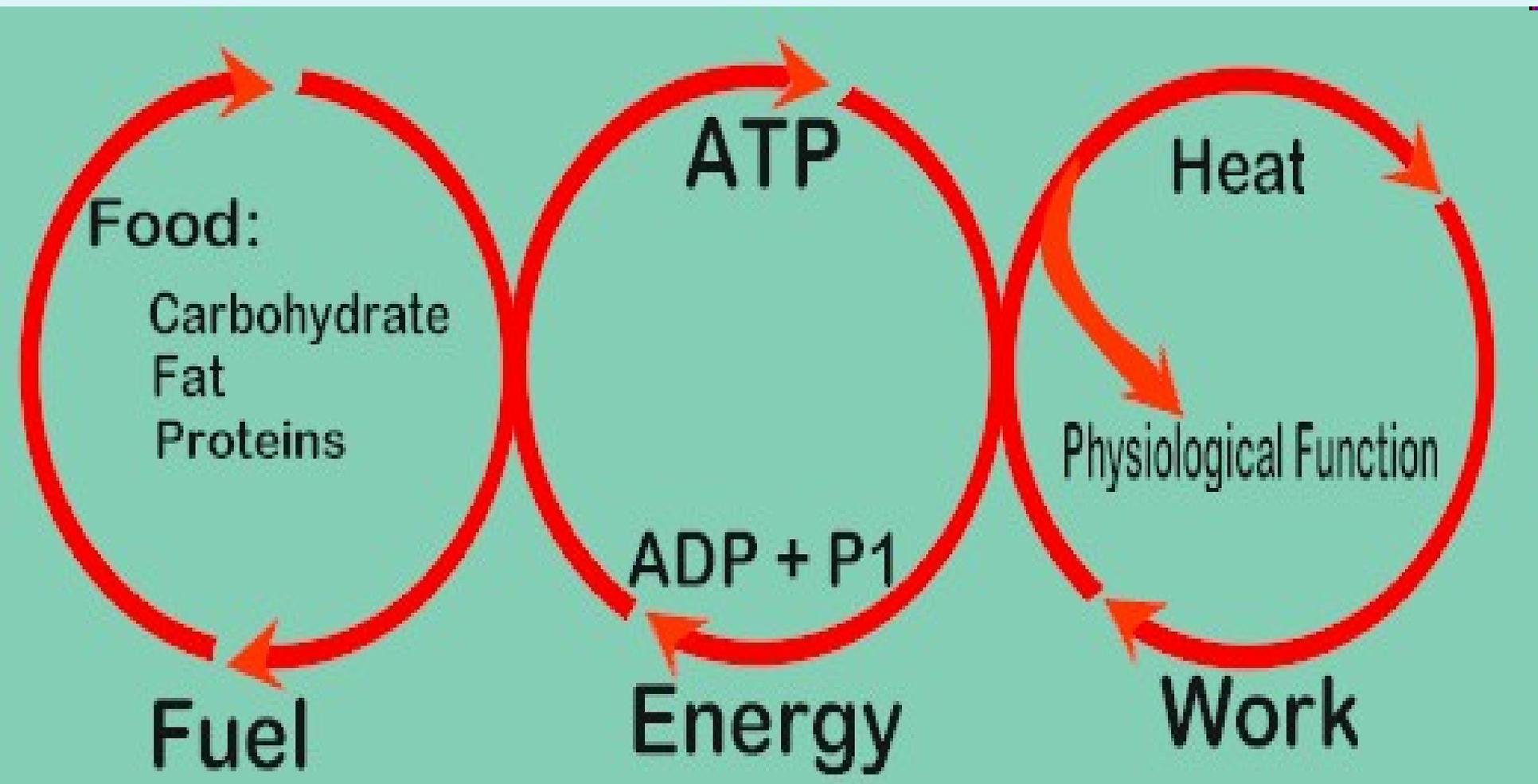
6-11 servings

**BREAD, CEREAL, RICE,  
& PASTA GROUP**

**Examples:**

- 1 oz ready-to-eat cereal
- 1/2 cup cooked cereal, pasta or rice
- 1 slice bread





# 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  $\text{Na}^+/\text{K}^+$  pumps and other pumps)



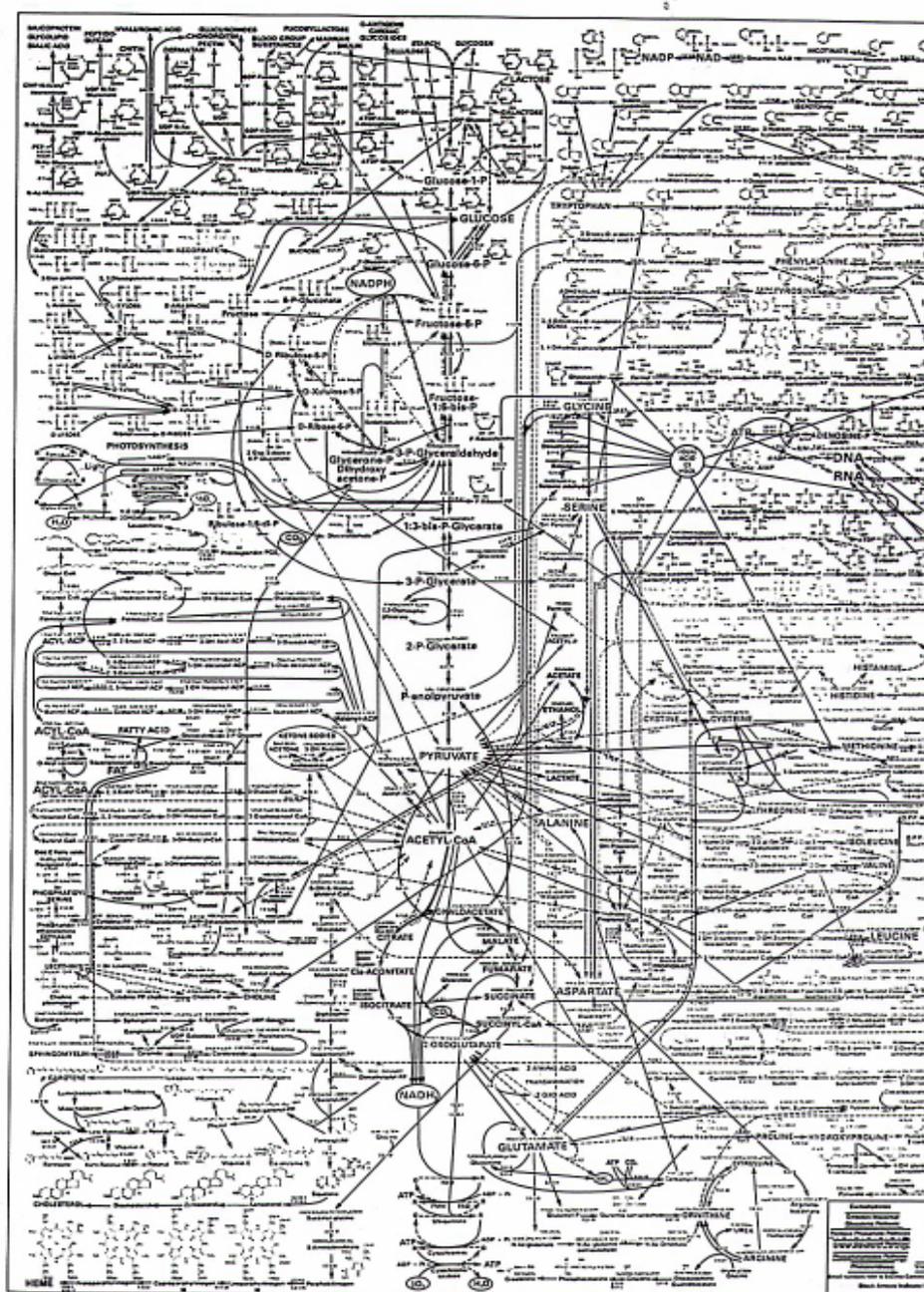
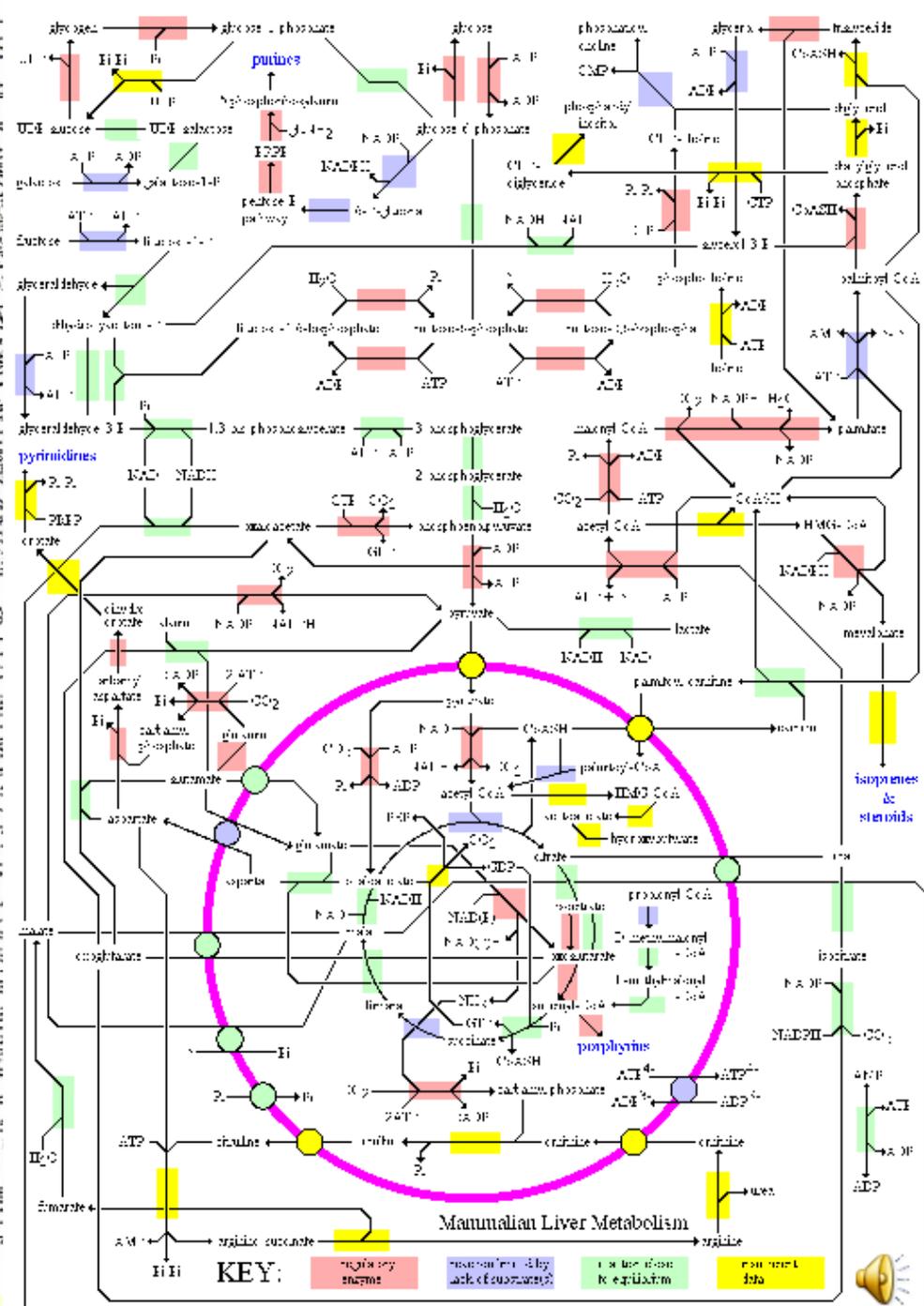
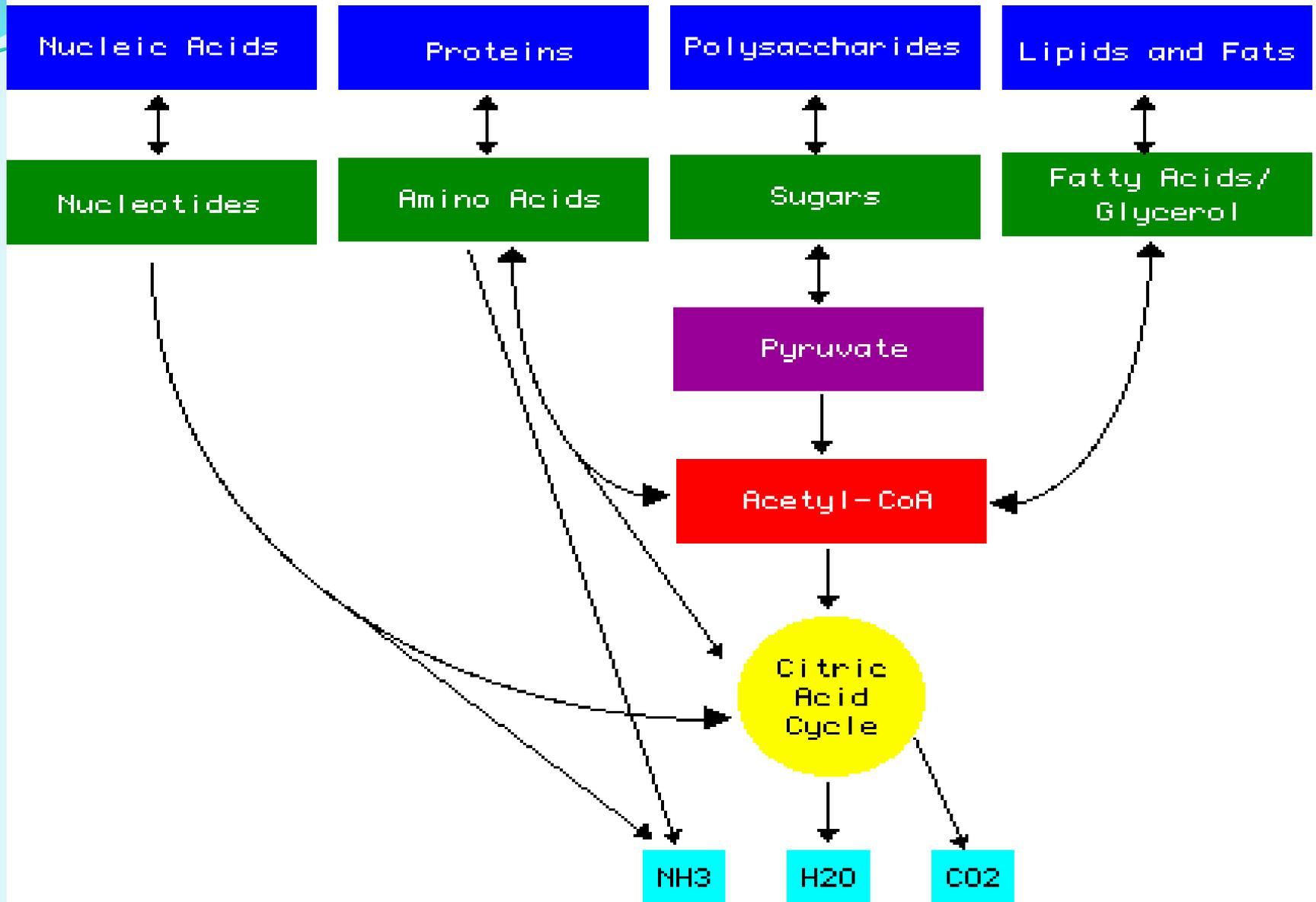


Figure 17.1 A metabolic map, indicating the reactions of intermediary metabolism and the enzymes that catalyze different chemical intermediates, or metabolites, and a greater number of enzymes are represented here. (Courtesy of D. E. Nicholson, University of Leeds, U.K., and the Sigma Chemical Co.)





# Fat

# Carbohydrate

# Protein

Triglycerides

Glucose

Amino Acids

Glycerol + Free Fatty Acids (FFA)

Glycolysis

Deamination Transamination

Pyruvic Acid

Keto Acids

Beta Oxidation

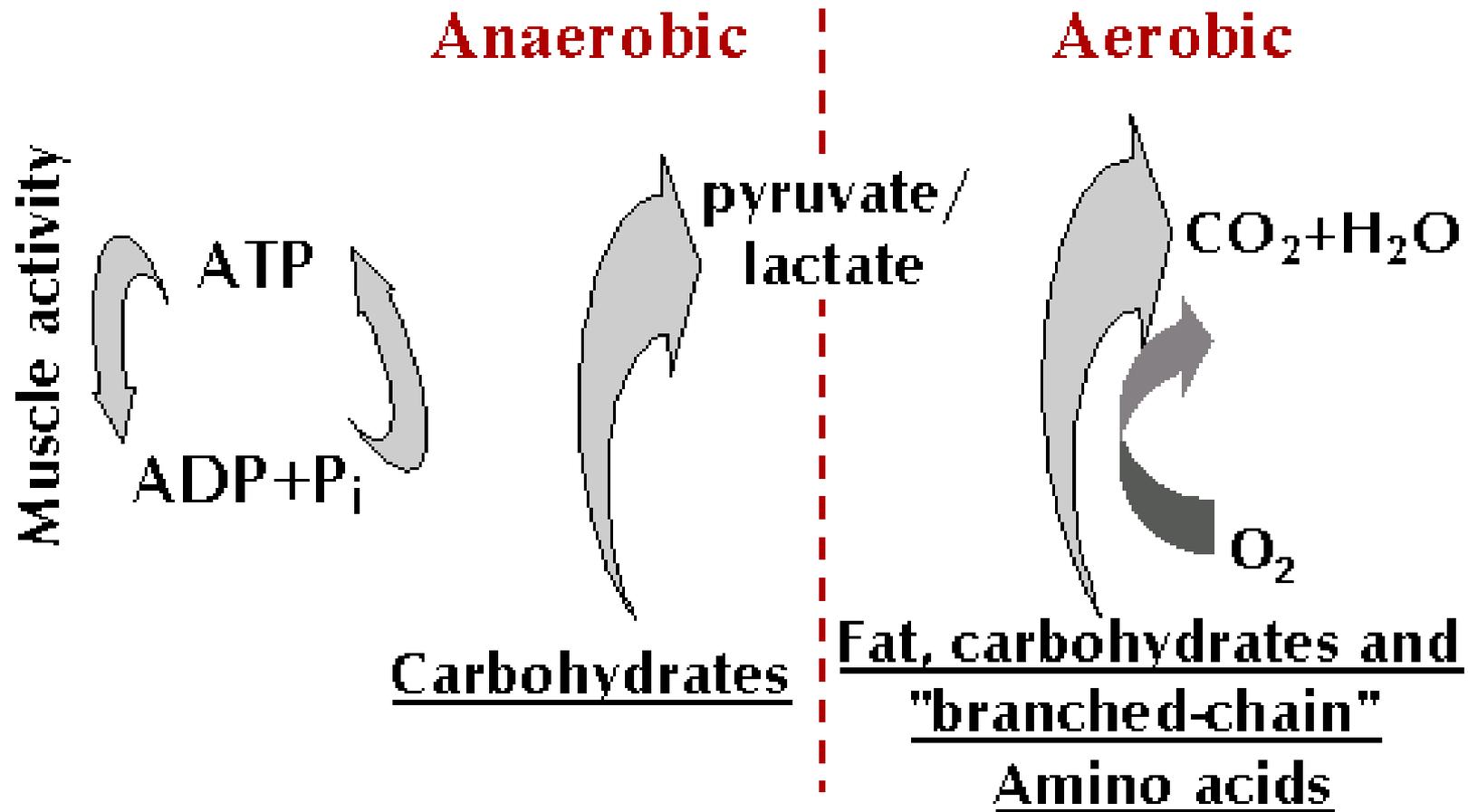
Acetyl CoA

Krebs Cycle

Electron Transport and Oxidative Phosphorylation



# Muscle work and Energy



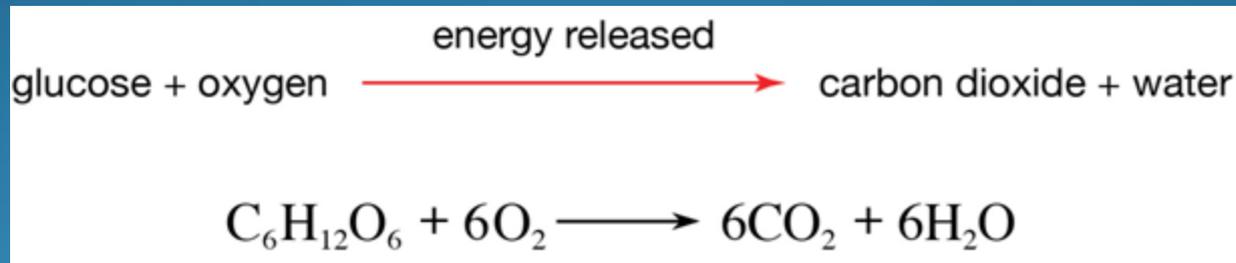
# Respiratory Quotient (RQ)

$$\text{Respiratory Quotient} = \frac{\text{volume of carbon dioxide per unit time}}{\text{volume of oxygen per unit time}}$$



# Respiratory Quotient (RQ)

By calculating **RQ** = We can get an estimate about **the main fuel of food stuff for our body energy**



By using Carbohydrates as Fuel: RQ is = 1

Fat as Fuel: RQ = 0.7

Proteins as Fuel: RQ = 0.82



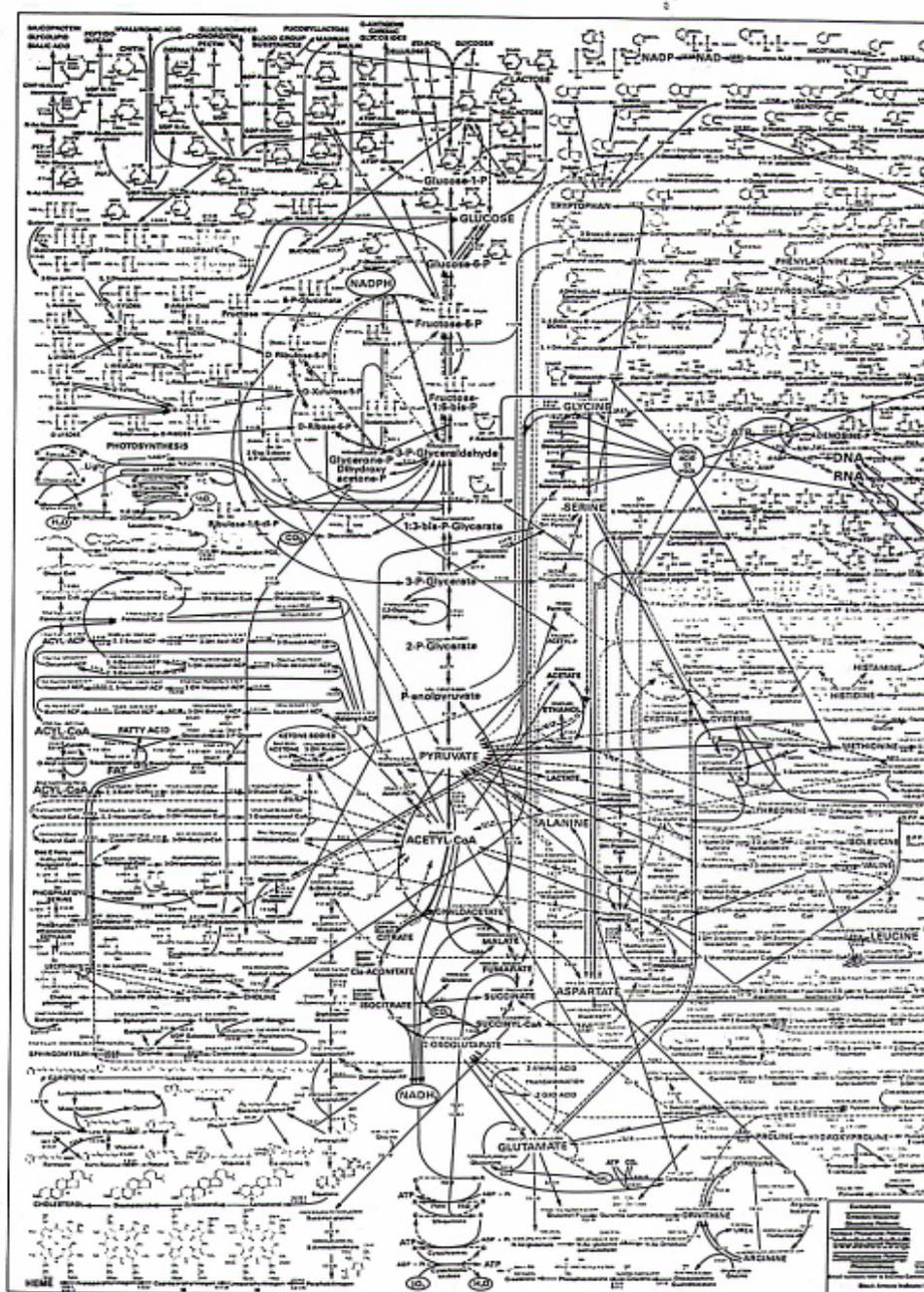
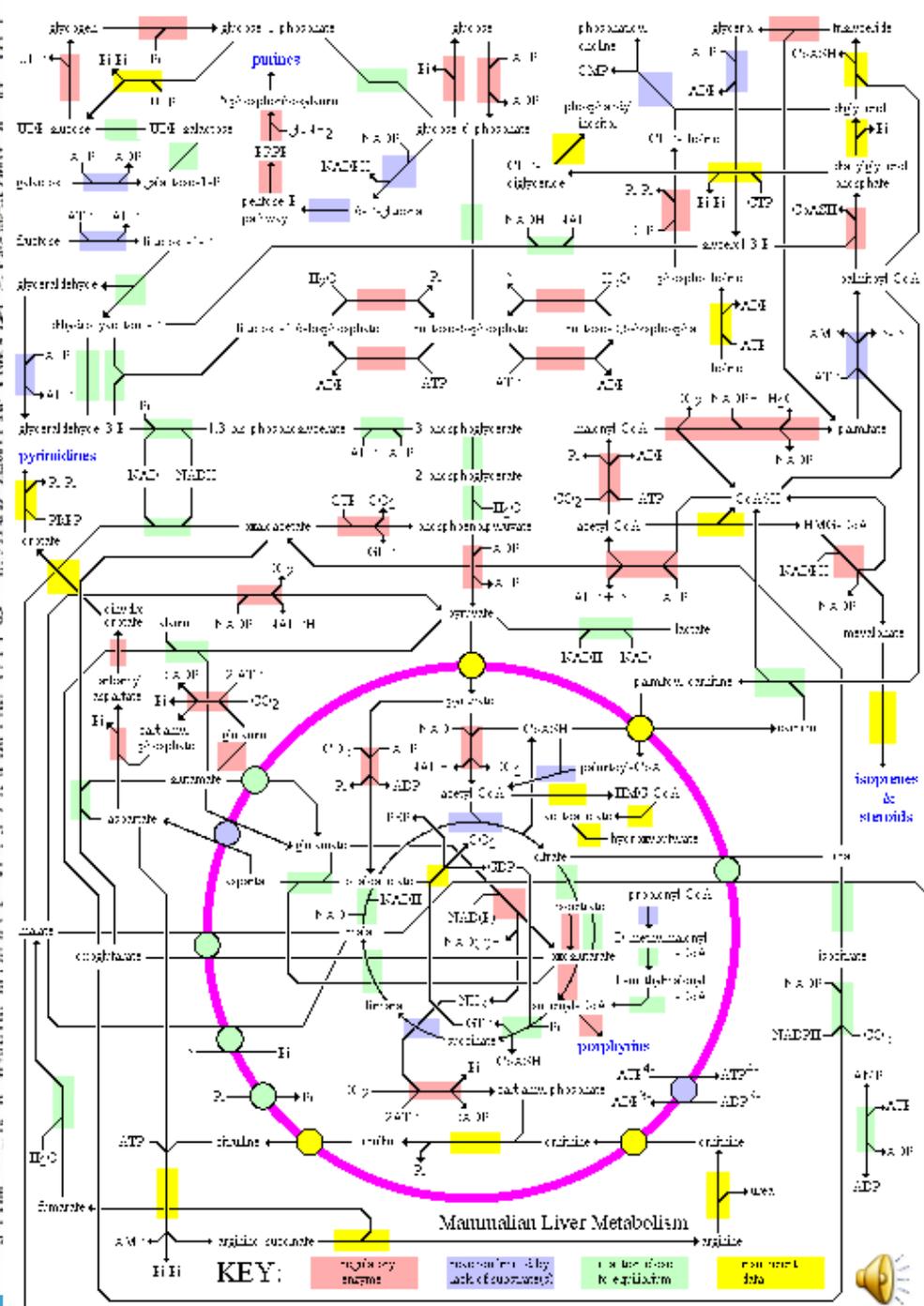


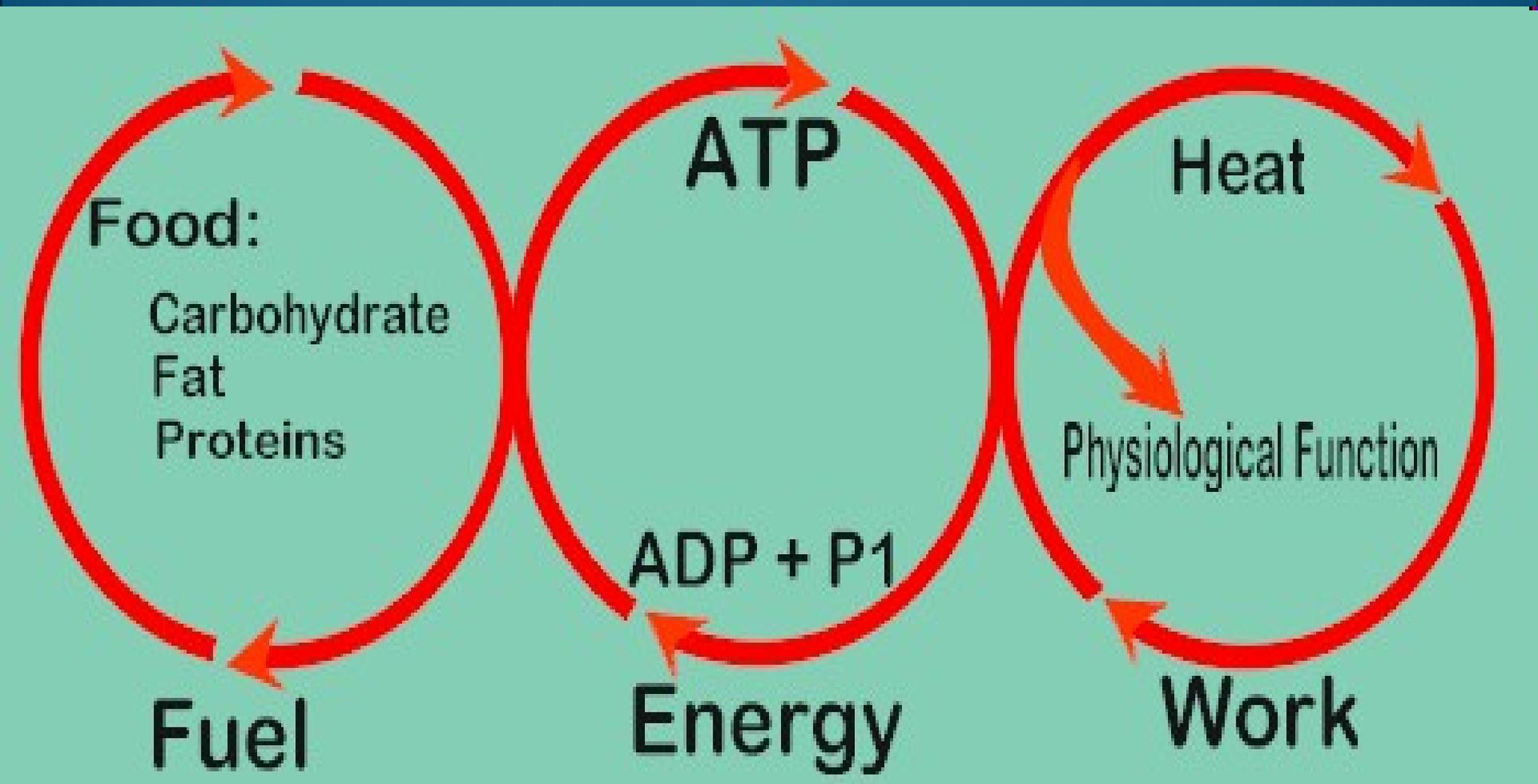
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# Metabolic Rate

**Metabolic activity / Unit time**





# Metabolic Rate

## Cal/Hour

- **Measurements:**

- **Direct Calorimetry**

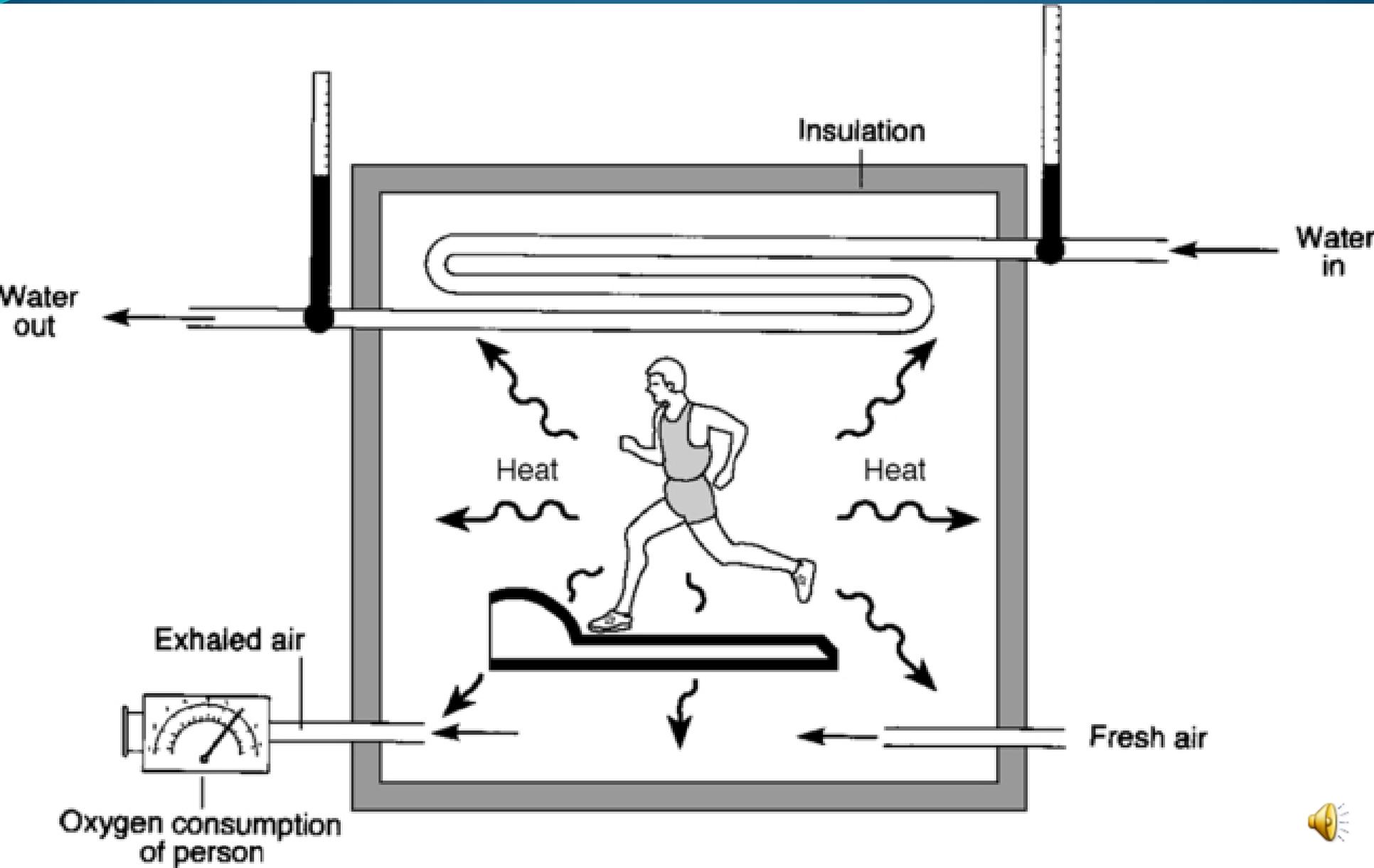
- Indirect Calorimetry

  - (O<sub>2</sub> consumption)

  - Closed method

  - Opened method





# Metabolic Rate

## Cal/Hour

- **Measurements:**
  - Direct Calorimetry
  - **Indirect Calorimetry**  
**(O<sub>2</sub> consumption)**
    - Closed method
    - Opened method



# Rate of Oxygen consumption per unit time

**:Energy Equivalent of OXYGEN**

**,Cal/1liter of Oxygen Consumption 4.8**

Example of calculation:

liter of Oxygen Consumption/5minutes  $\square$  12 liters/hour 1

Metabolic rate will be:  $12 \times 4.8 = 57.6$  Cal/Hour



# Metabolic Rate

## Cal/Hour

- **Measurements:**

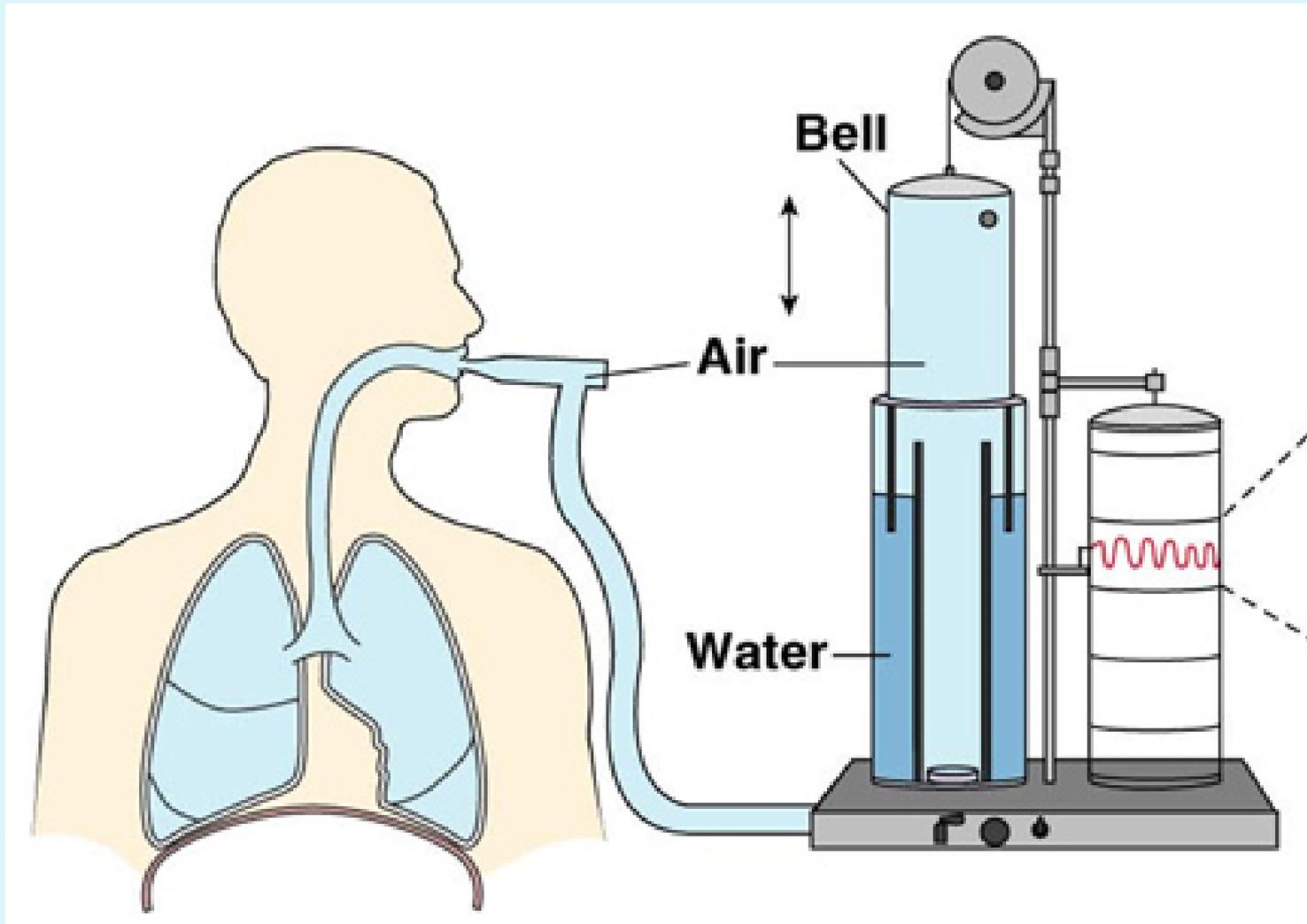
- O<sub>2</sub> consumption:**

- **Closed method**
    - Opened method



# Spirometer

)measurement of O<sub>2</sub> consumption(



# Metabolic Rate

## Cal/Hour

- **Measurements:**

  - O<sub>2</sub> consumption:**

    - Closed method
    - **Opened method**





# Standardization of Measurement

Relating Metabolic Rate to **1 Meter square-Surface area of the body.**

Cal/hour/m<sup>2</sup> (**Cal.h<sup>-1</sup>.m<sup>-2</sup>**) 36 = 57.6/1.6

Measurement under basal Conditions-



# 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 -
- Elimination of all factors that may cause -
  - .excitement
- Comfortable temperature during -
  - .measurement



# 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

- **Neutral Balance**

Calories In



Energy Intake  
"Calories in"

**Weight Stable**



Energy Expenditure  
"Calories out"

Daily Activity Out



- **Positive balance**



- **Negative balance**



# Food intake = Energy expenditure

- **Neutral Balance**

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Energy Expenditure  
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Daily Activity Out



# Hypothalamic control of food intake

..**Feeding center**: lateral nuclei

**Satiety center**: ventromedial nuclei

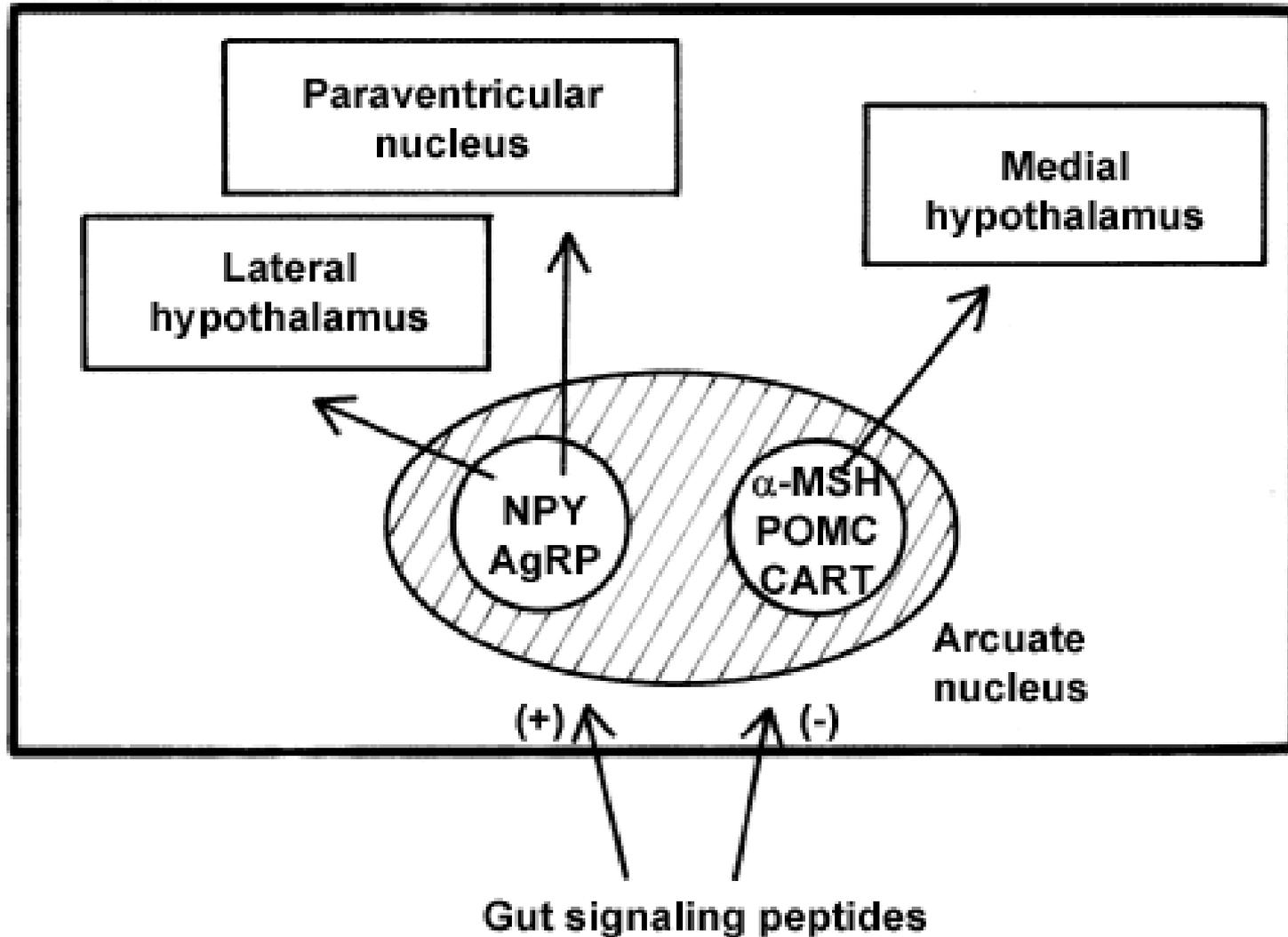
Amygdala (destruction  $\square$  psychic blindness)

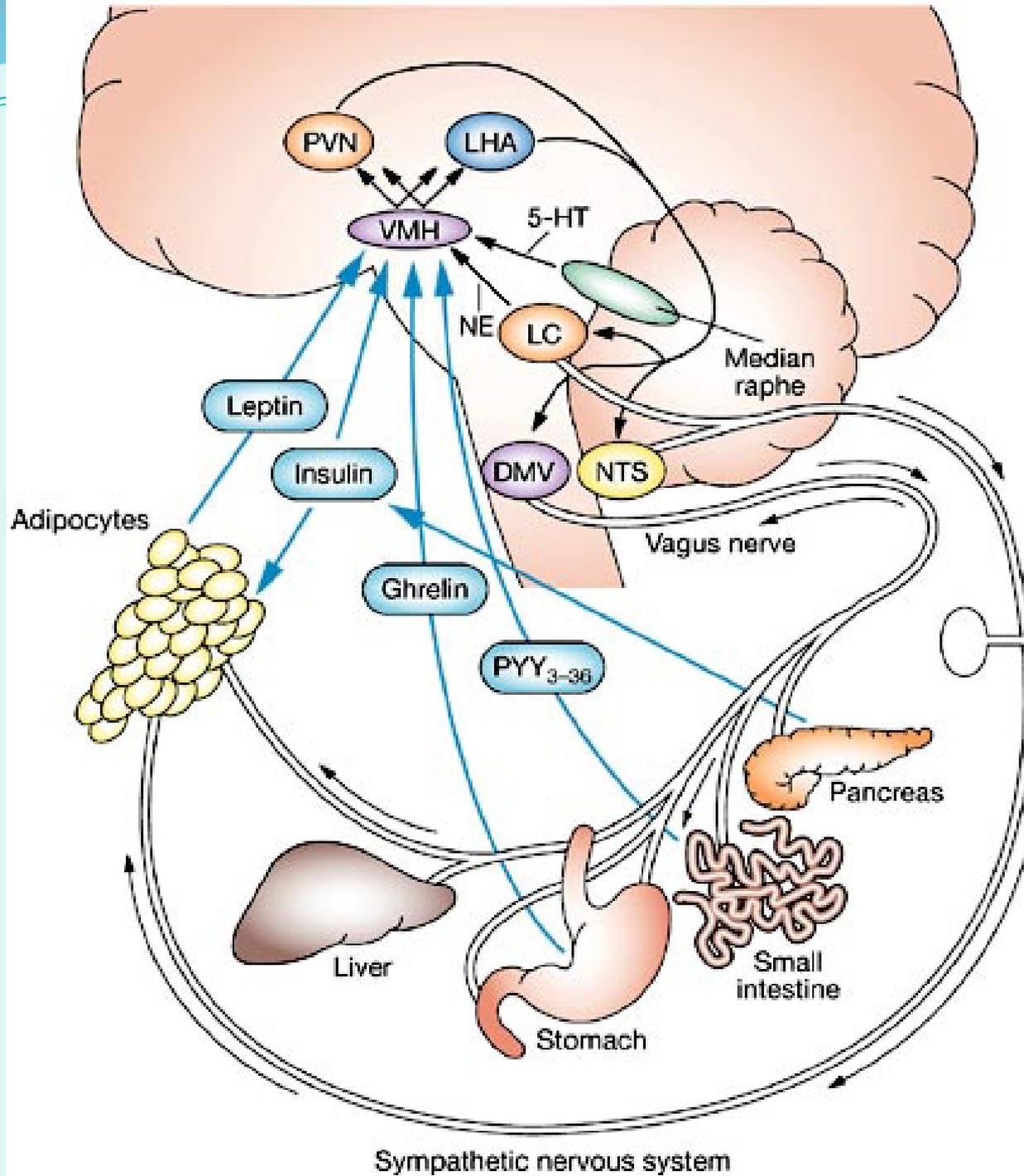
:prefrontal cortex



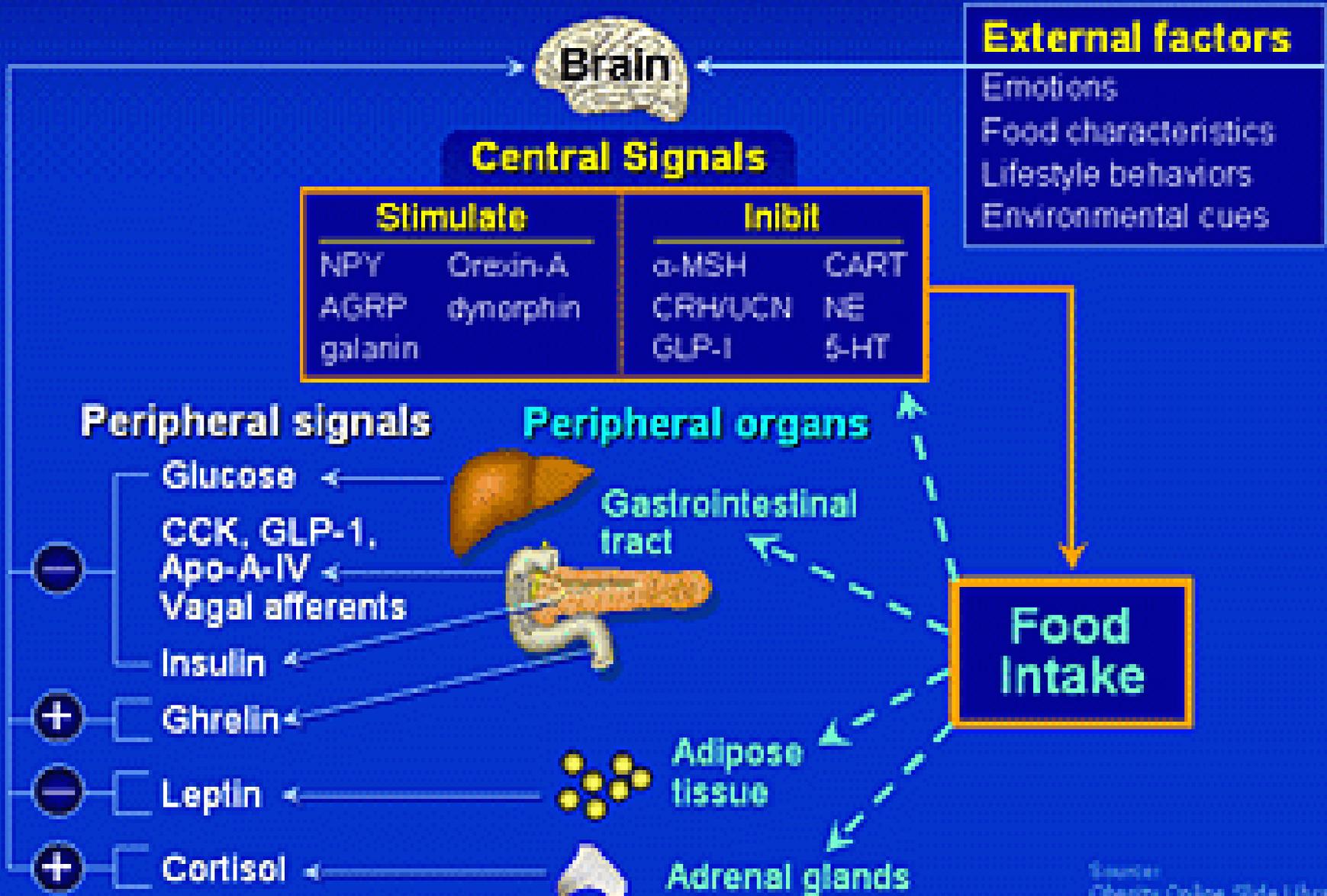
Hunger center

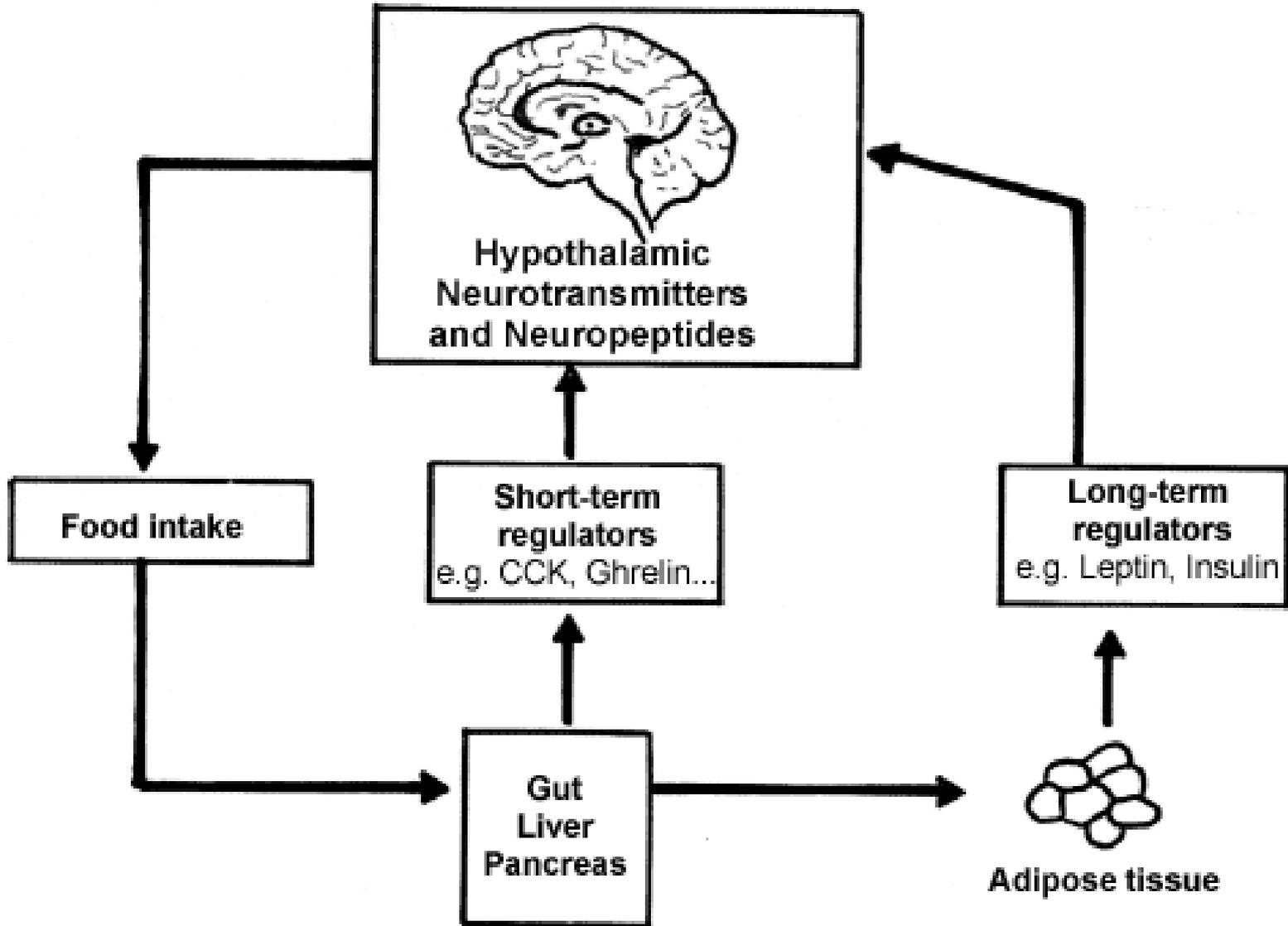
Satiety center





# Regulation of Food Intake





# 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  
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**:Psychosocial factors**



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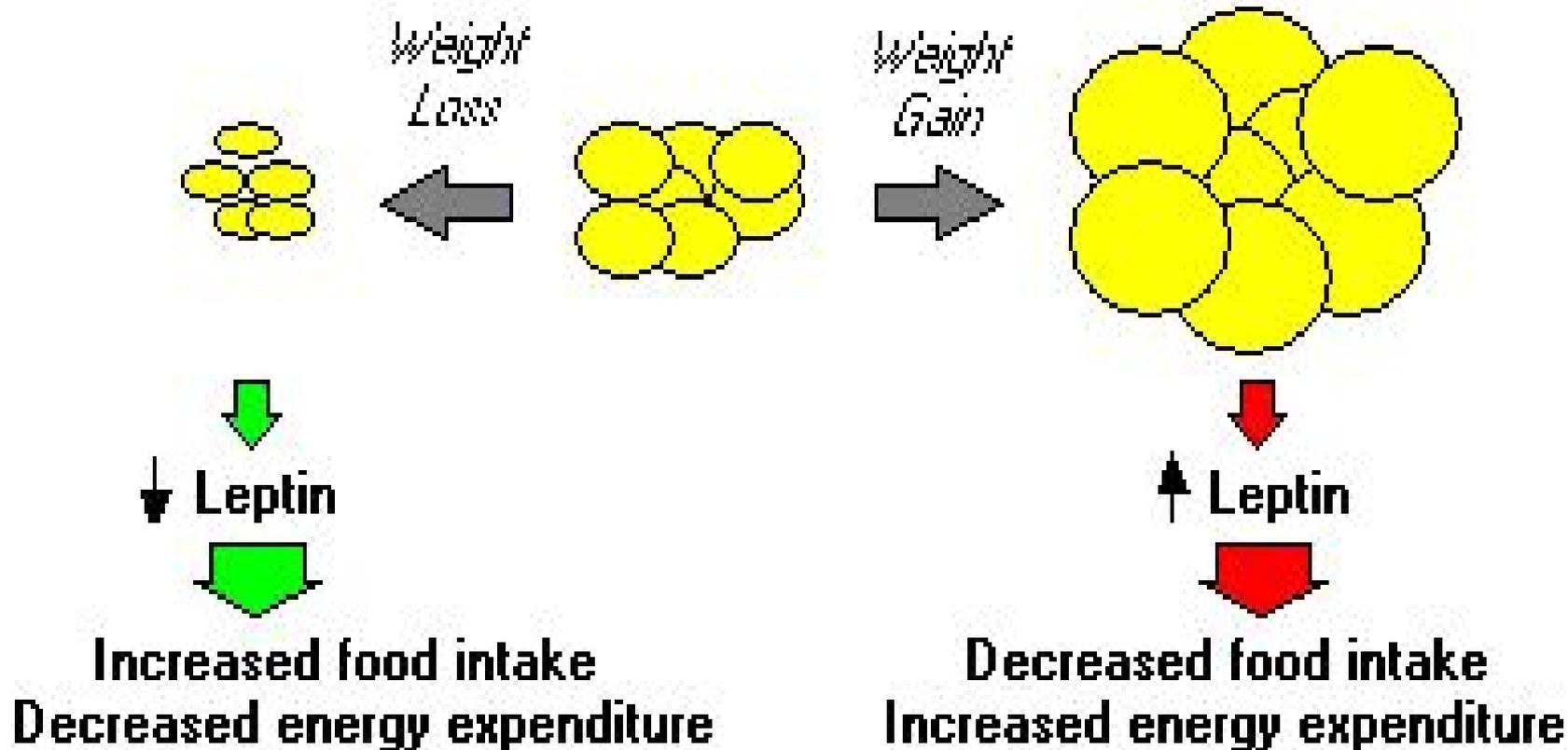
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:**Psychosocial factors**



# Short term regulation of food intake

These are rapid signals that affect  
.feeding

**:Gastrointestinal filling**

**:Hormonal factors**

**:Suppression by oral receptors**



# Obesity

- Positive balance



# 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



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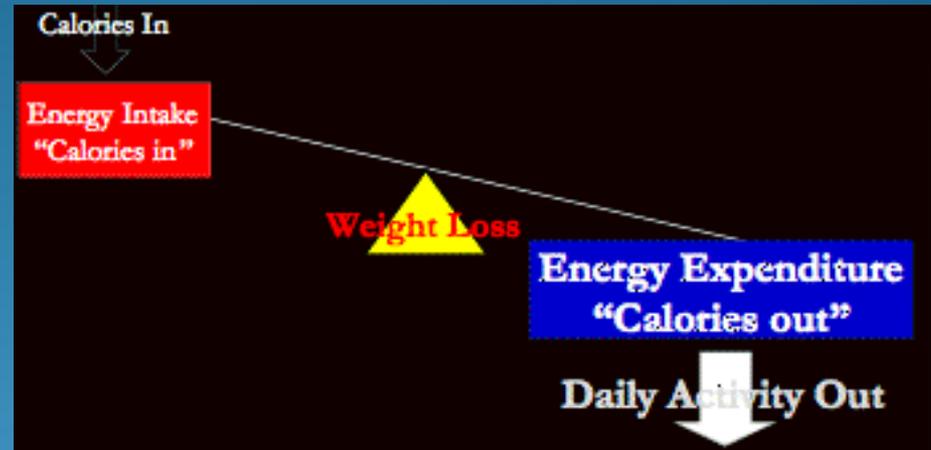
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# Inanition

- **Negative balance**

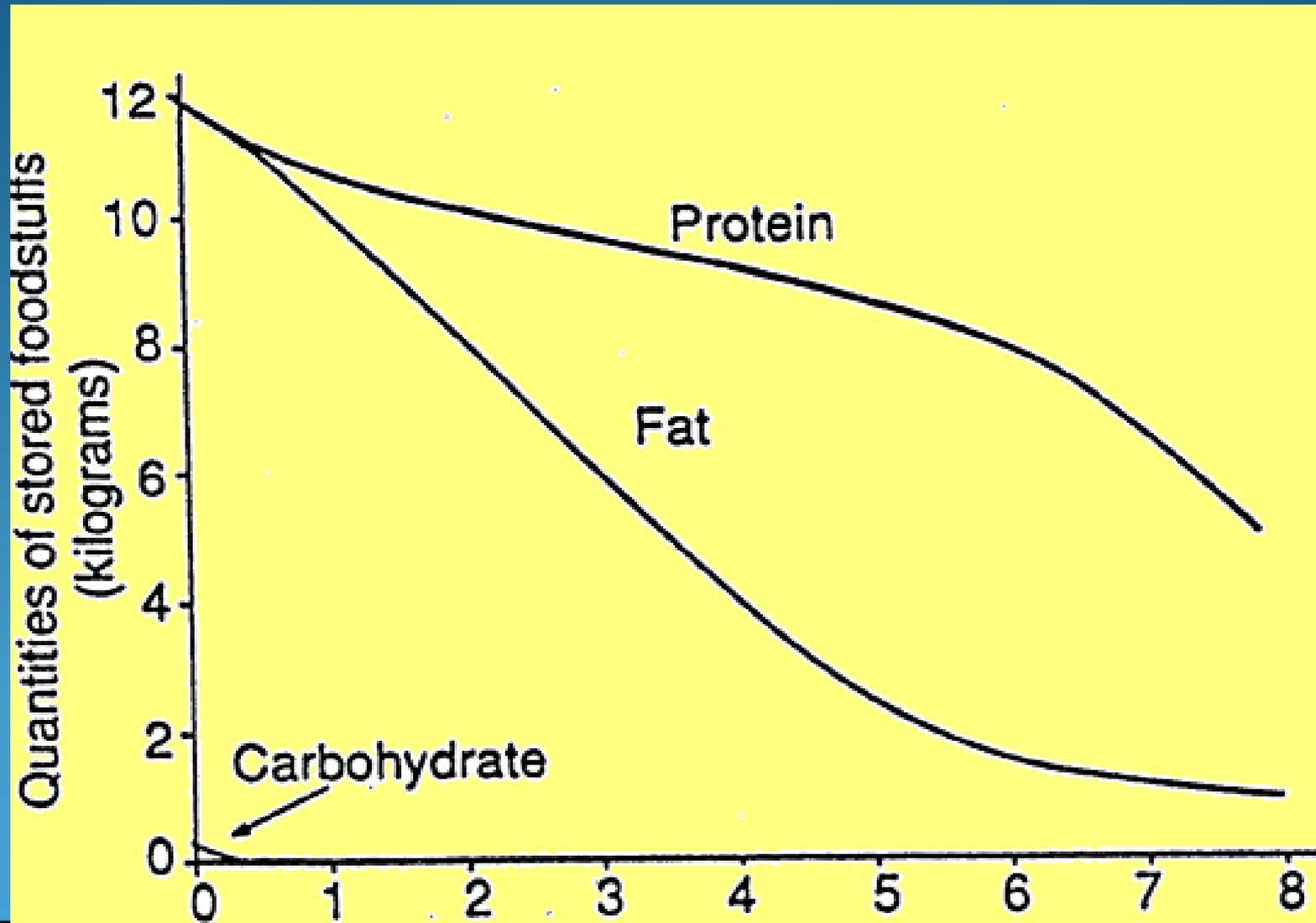


Causes:

psychogenic (anorexia nervosa) or hypothalamic abnormalities



# Starvation and depletion of stores in the body



# GOOD LUCK

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