

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

VEGETABLE GROUP

Examples:

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



3-5 servings

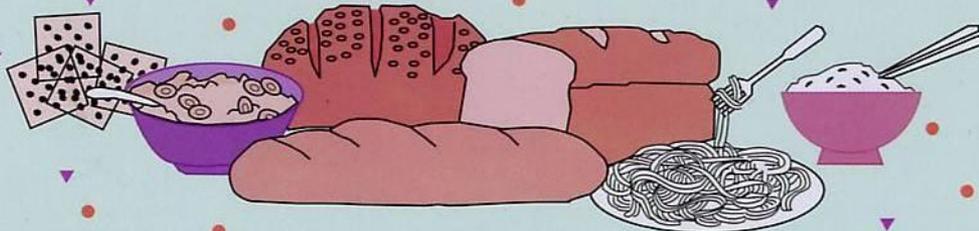


3-5 servings

FRUIT GROUP

Examples:

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

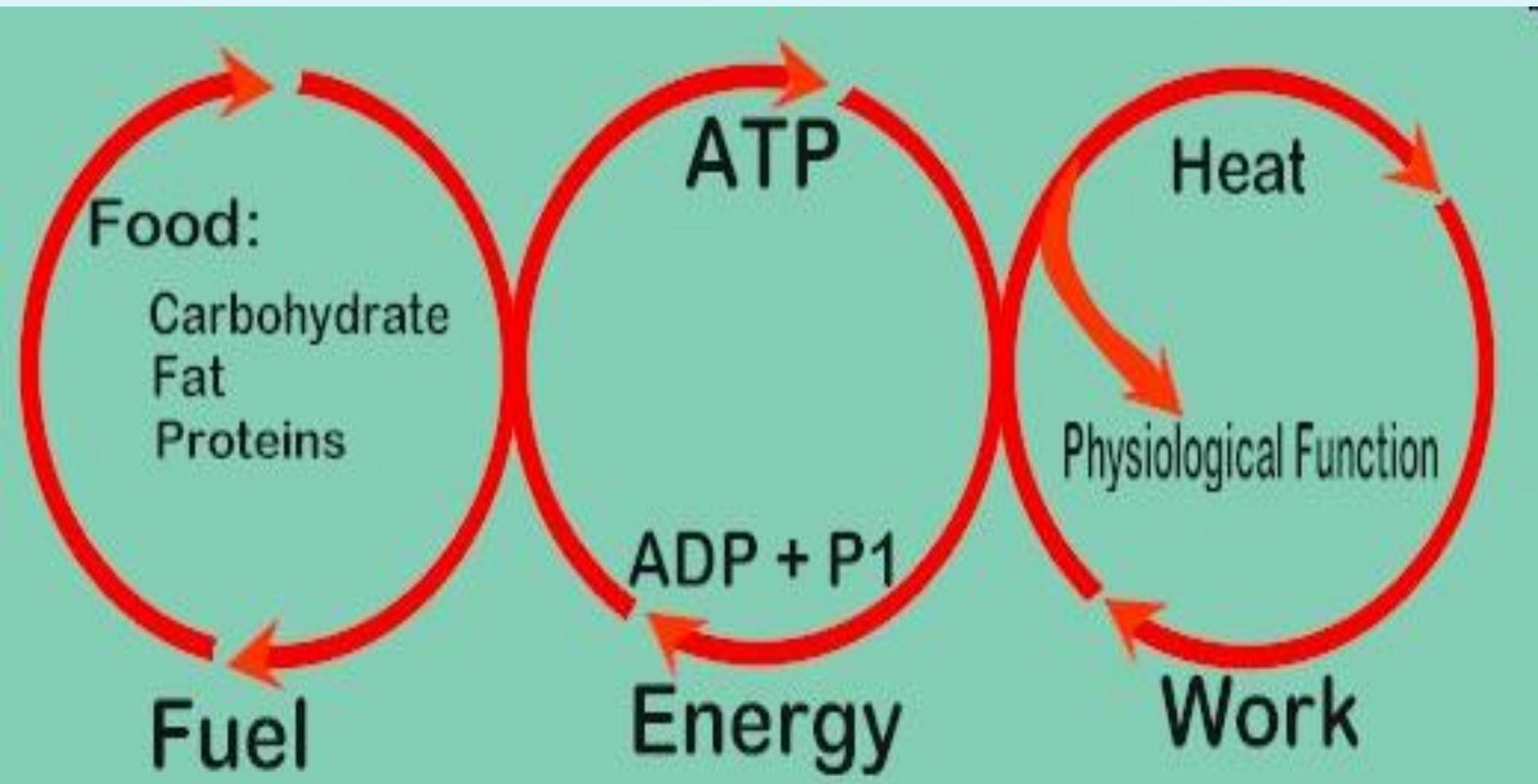


6-11 servings

**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 Na^+/K^+ pumps and other pumps).

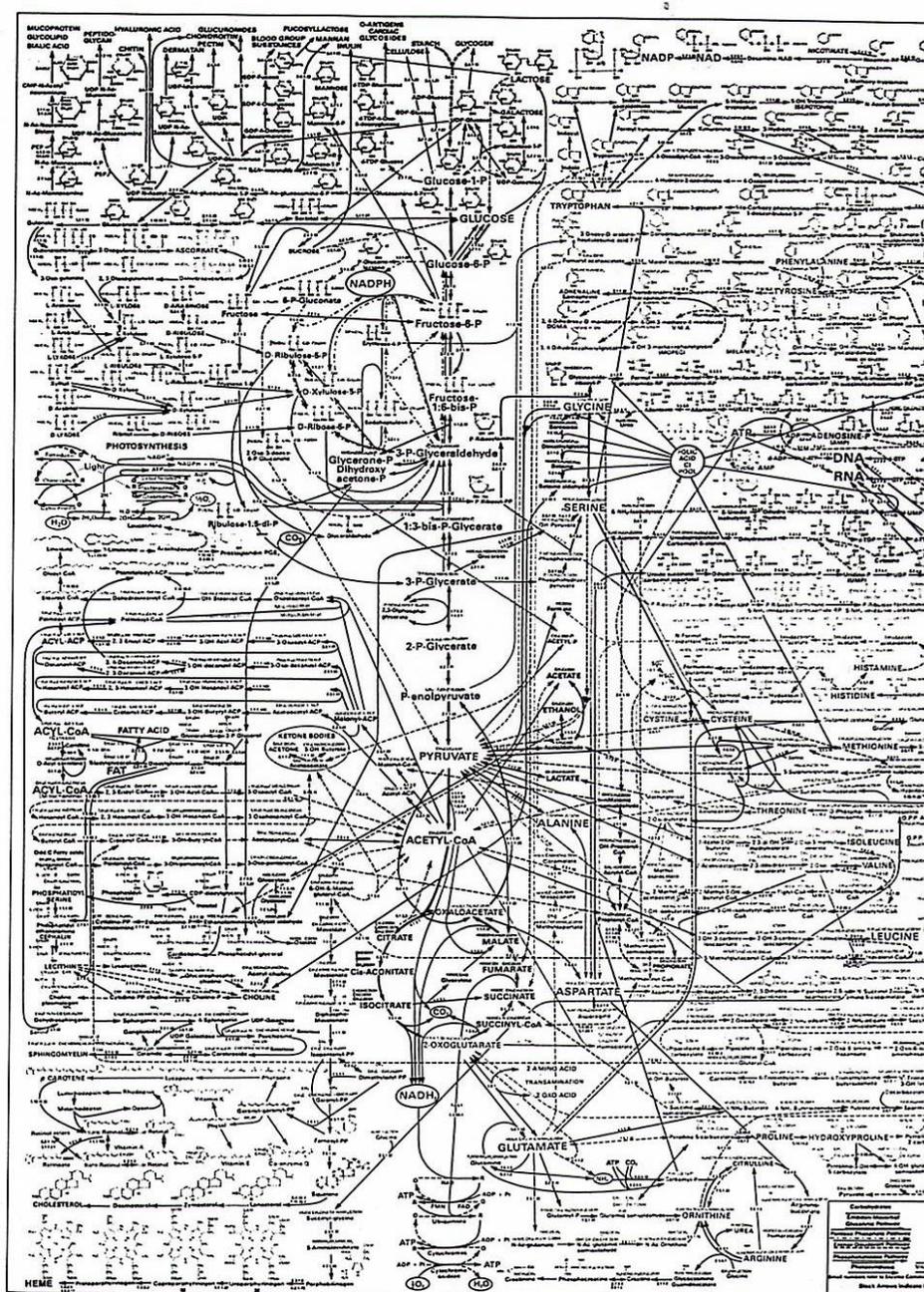
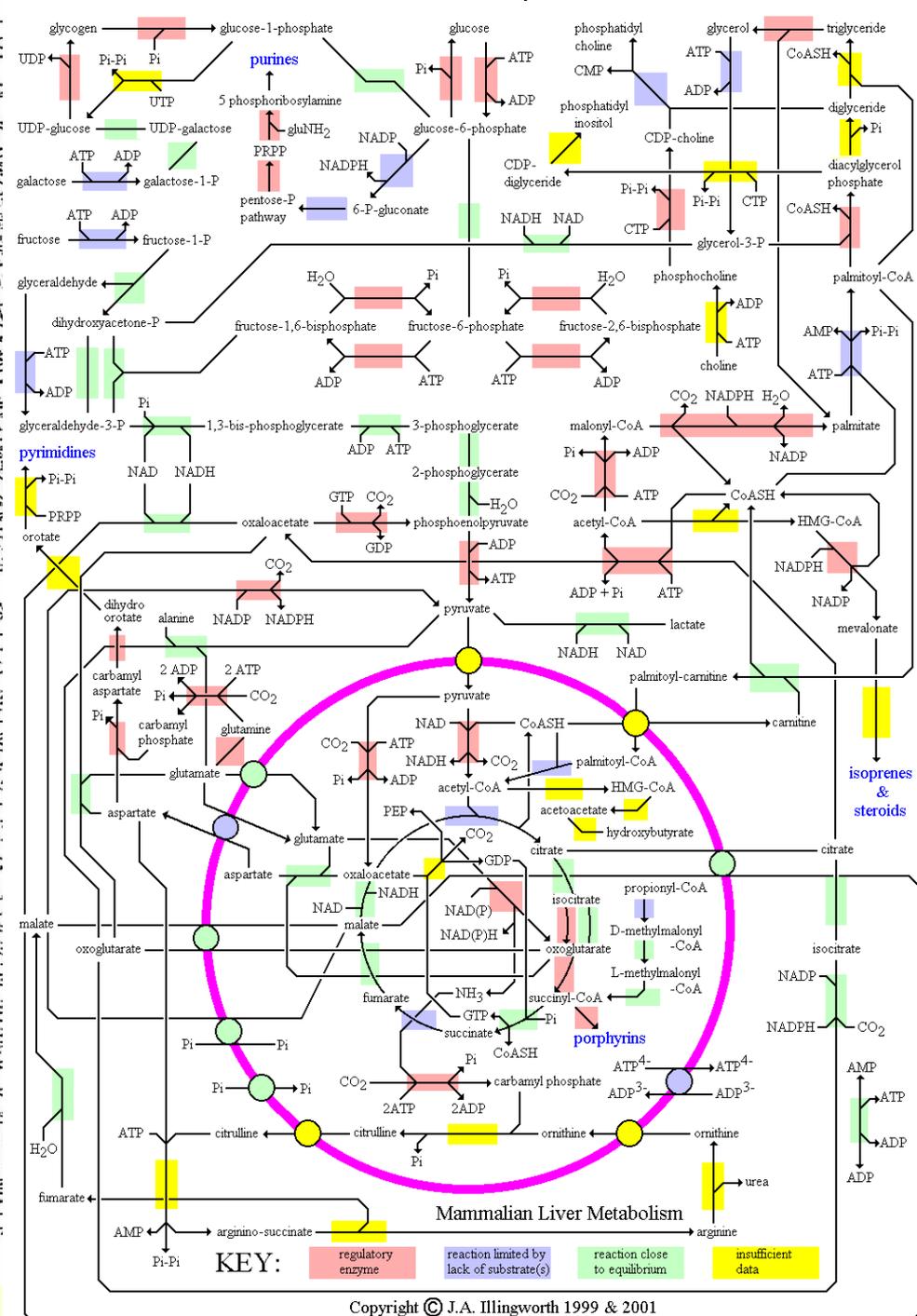
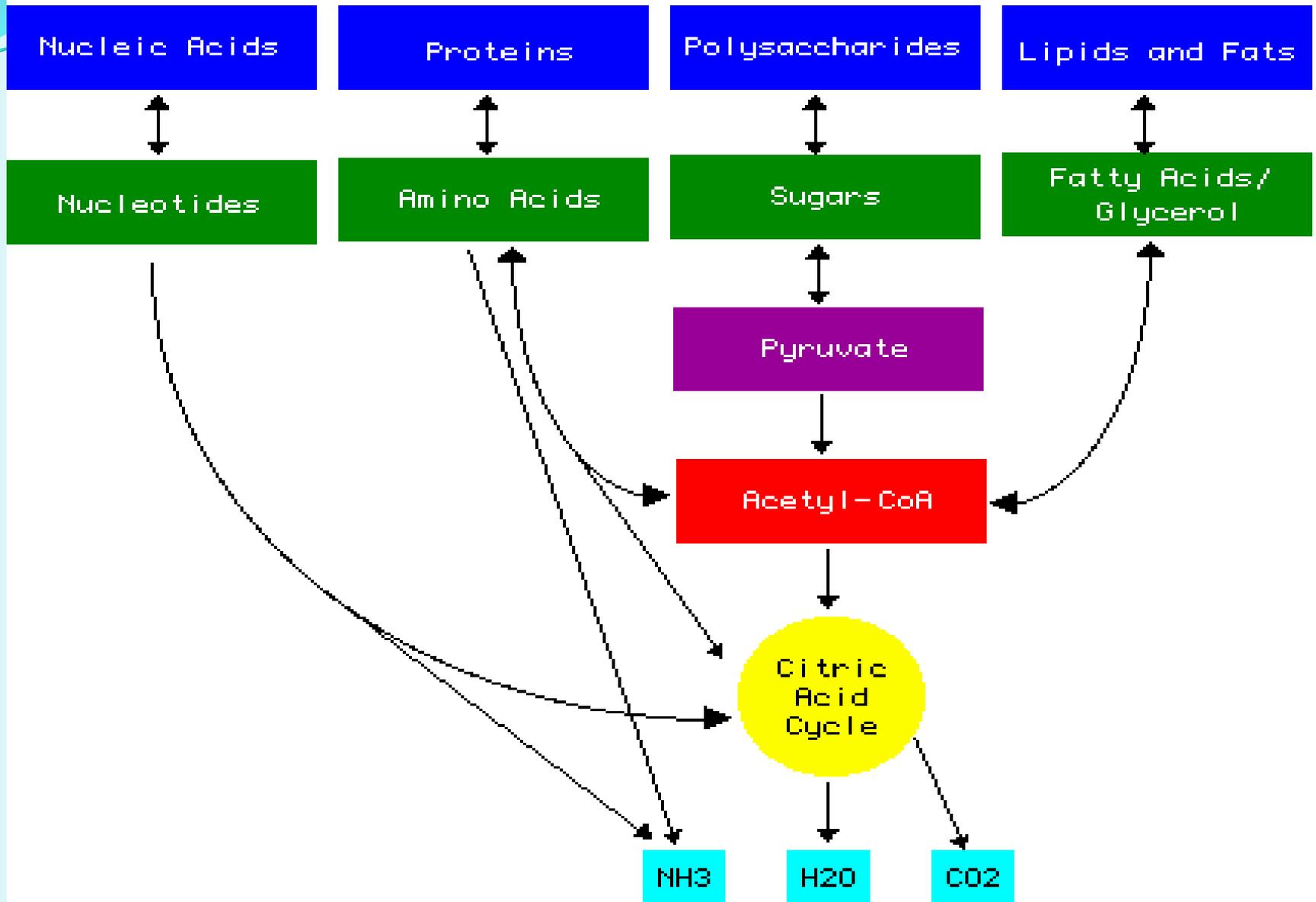


Figure 17.1 A metabolic map, indicating the reactions of intermediary metabolism and the enzymes that catalyze different chemical intermediates, or metabolites, and a greater number of enzymes are represented here. (Courtesy of D. E. Nicholson, University of Leeds, U.K., and the Sigma Chemical Co.)





Fat

Carbohydrate

Protein

Triglycerides

Glucose

Amino Acids

Glycerol + Free Fatty Acids (FFA)

Glycolysis

Deamination Transamination

Pyruvic Acid

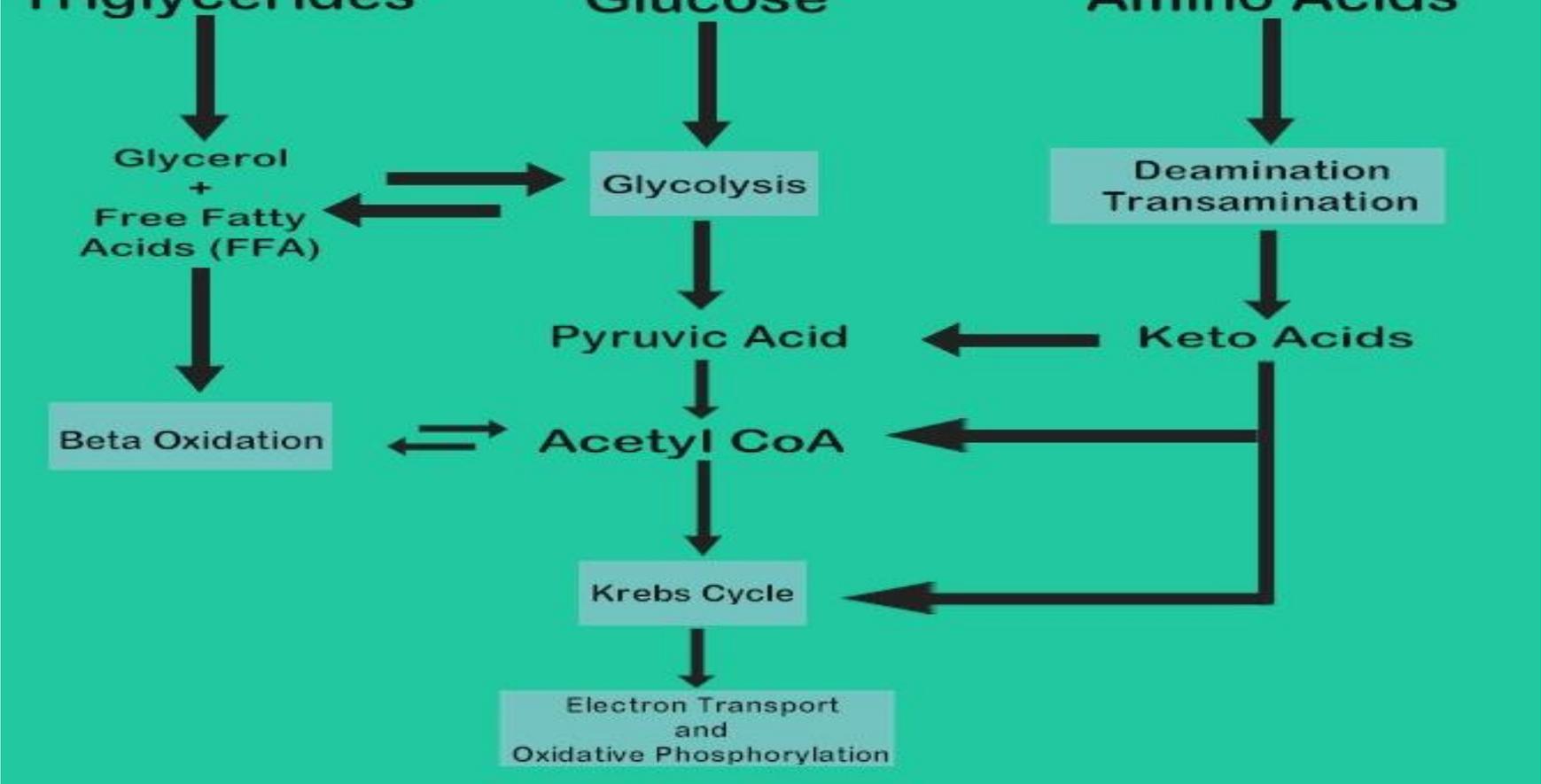
Keto Acids

Beta Oxidation

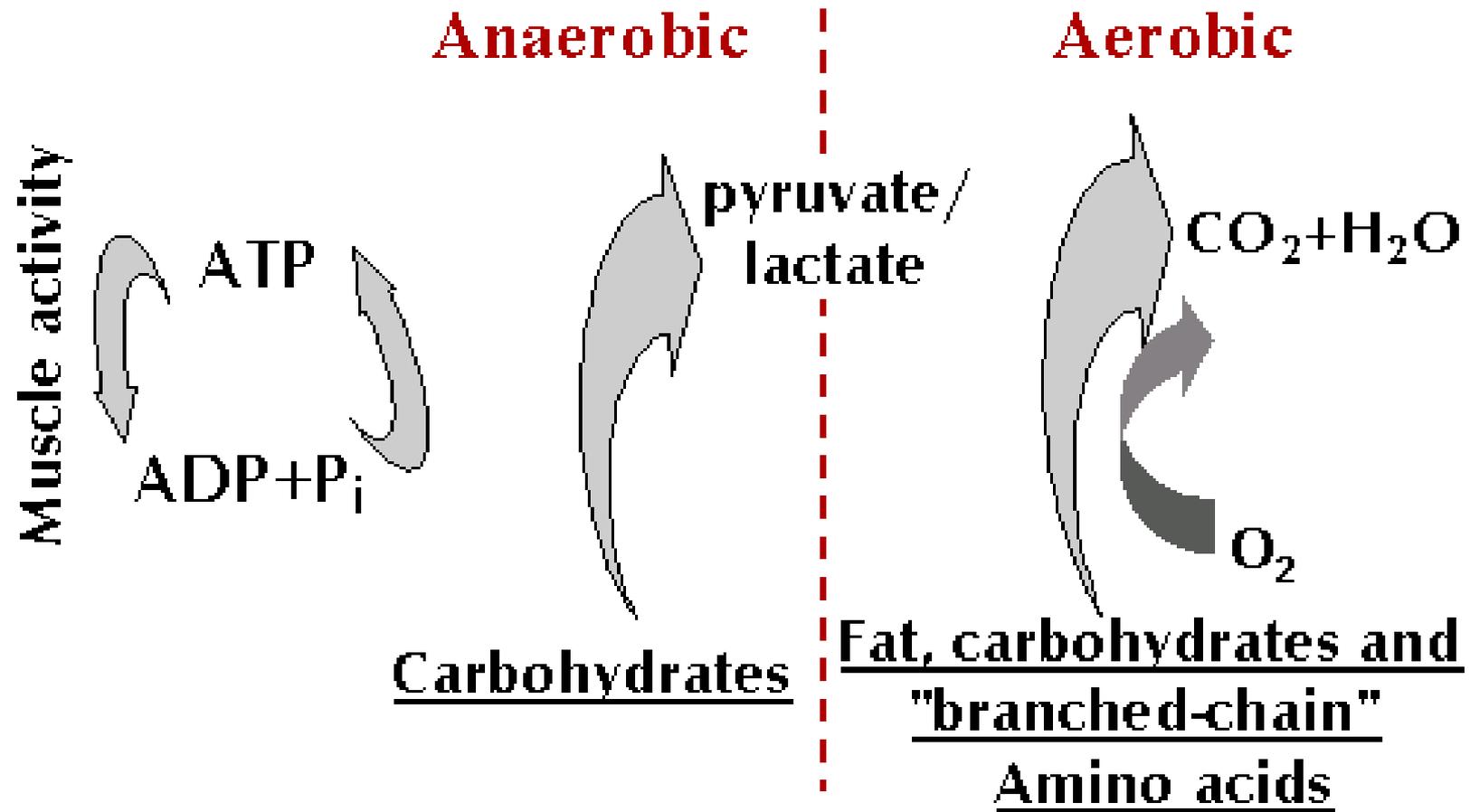
Acetyl CoA

Krebs Cycle

Electron Transport and Oxidative Phosphorylation



Muscle work and Energy



Respiratory Quotient (RQ)

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

Metabolic Rate

- **Measurements:**

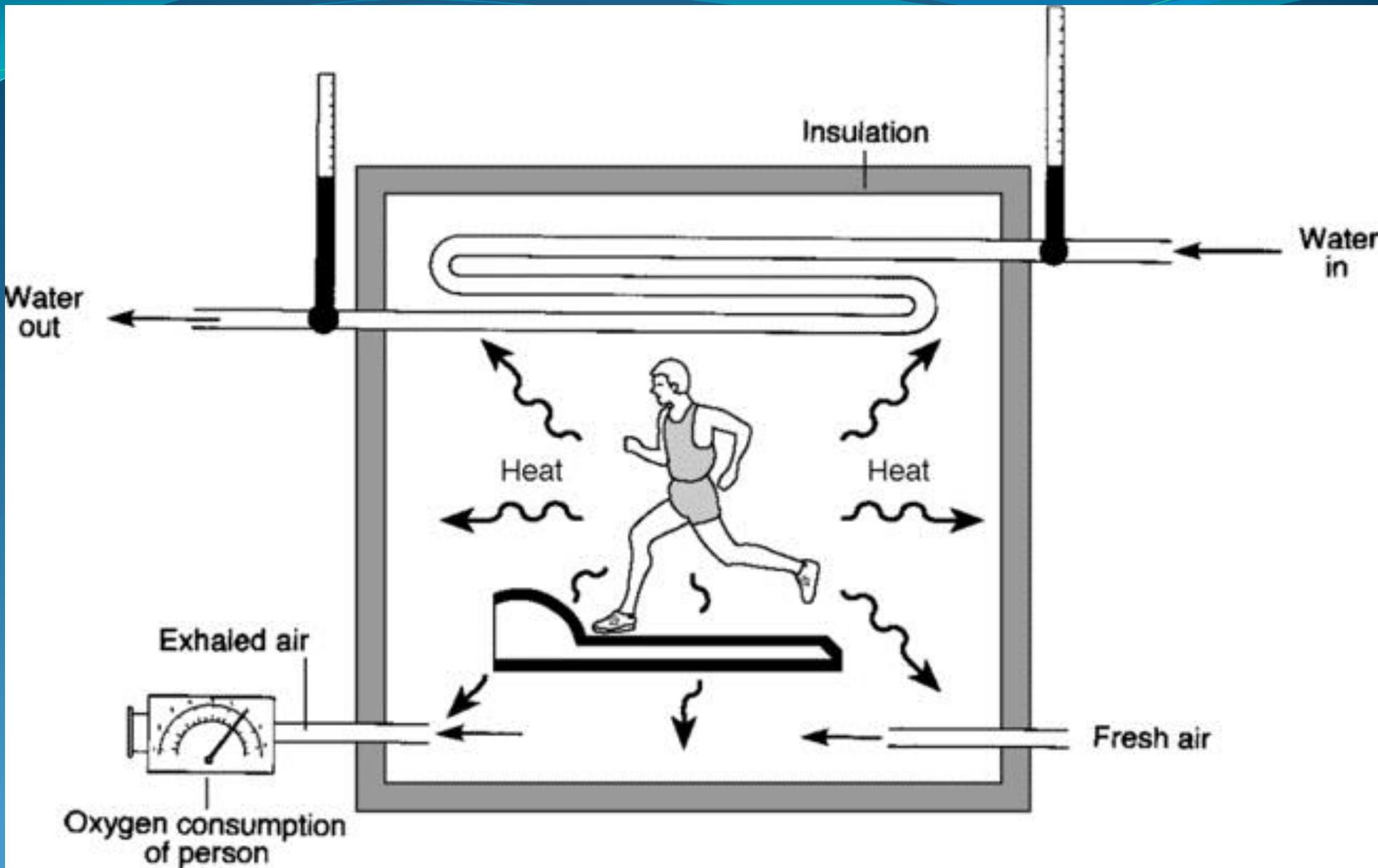
- **Direct Calorimetry**

- **Indirect Calorimetry**

- (O₂ consumption)**

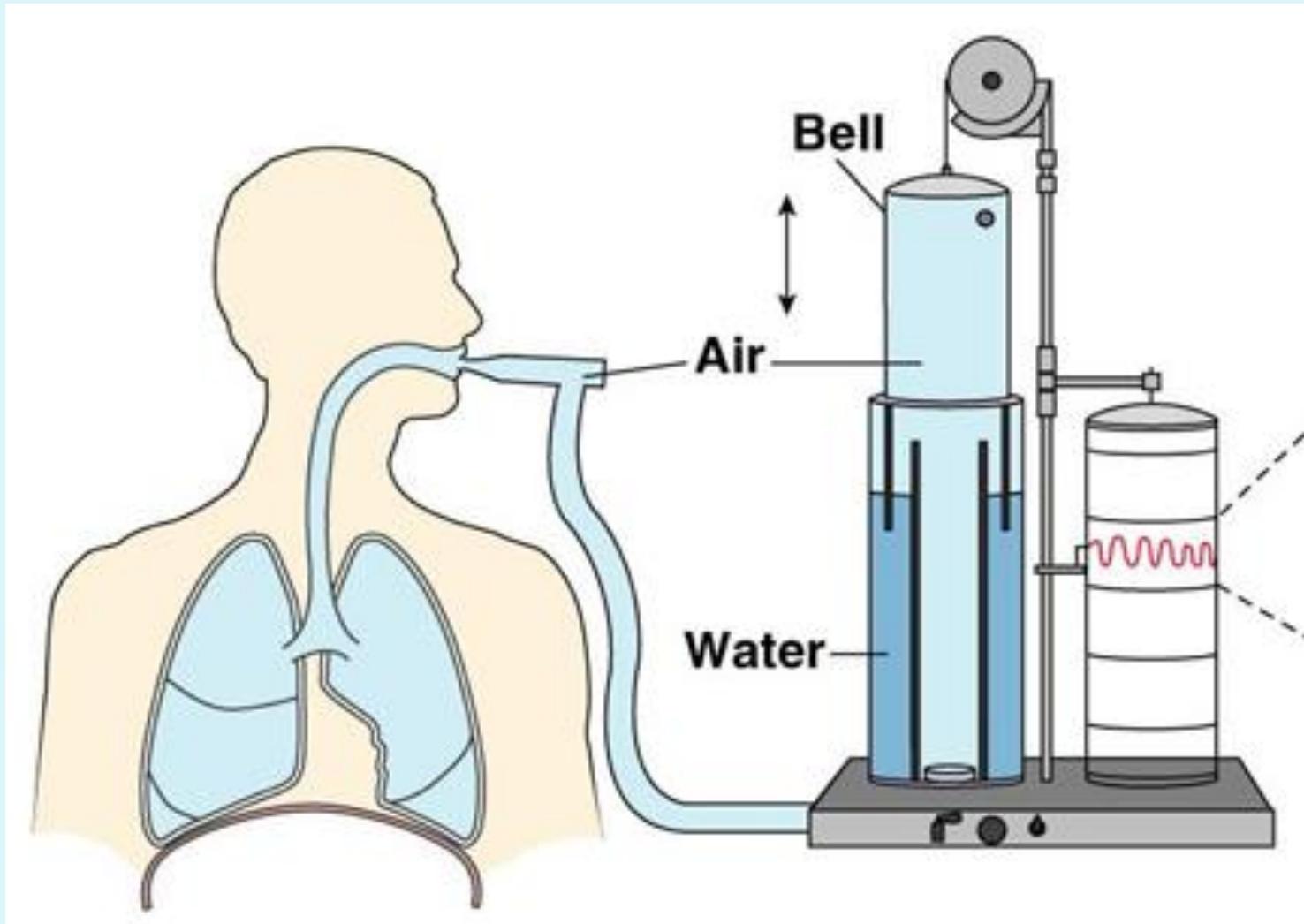
- Closed method

- 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.
- 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"

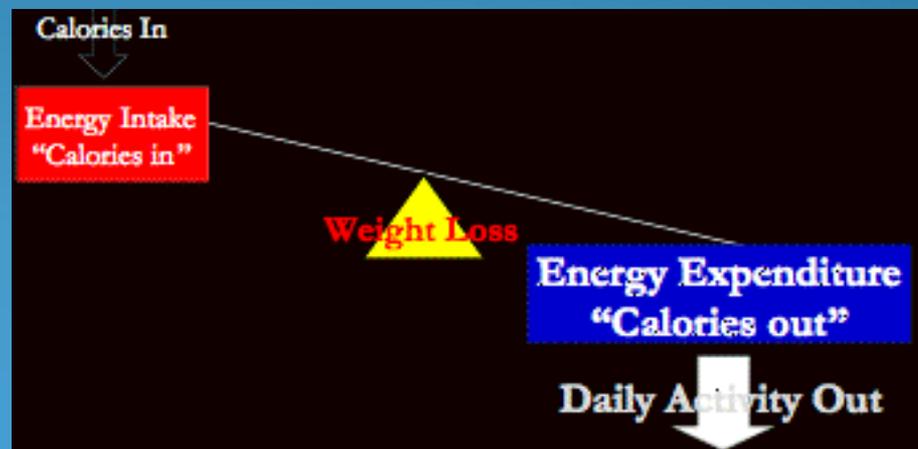
Daily Activity Out



- **Positive balance**



- **Negative balance**



Food intake = Energy expenditure

- **Neutral Balance**

Calories In



Energy Intake
"Calories in"

Weight Stable



Energy Expenditure
"Calories out"

Daily Activity Out



Hypothalamic control of food intake

Feeding center: lateral nuclei..

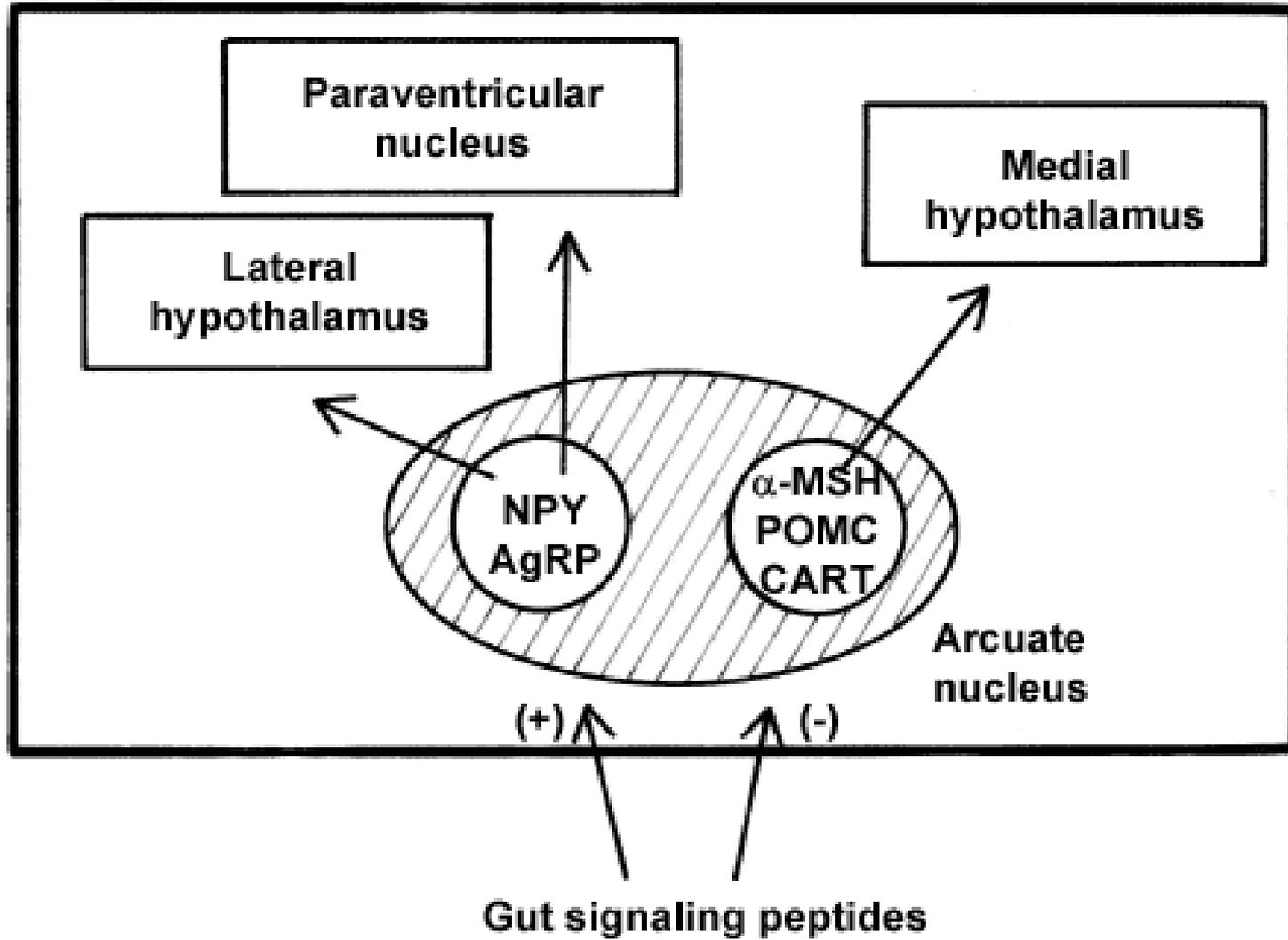
Satiety center: ventromedial nuclei

Amygdala (destruction →
psychic blindness.

prefrontal cortex:

Hunger center

Satiety center



Paraventricular nucleus

Medial hypothalamus

Lateral hypothalamus

NPY
AgRP

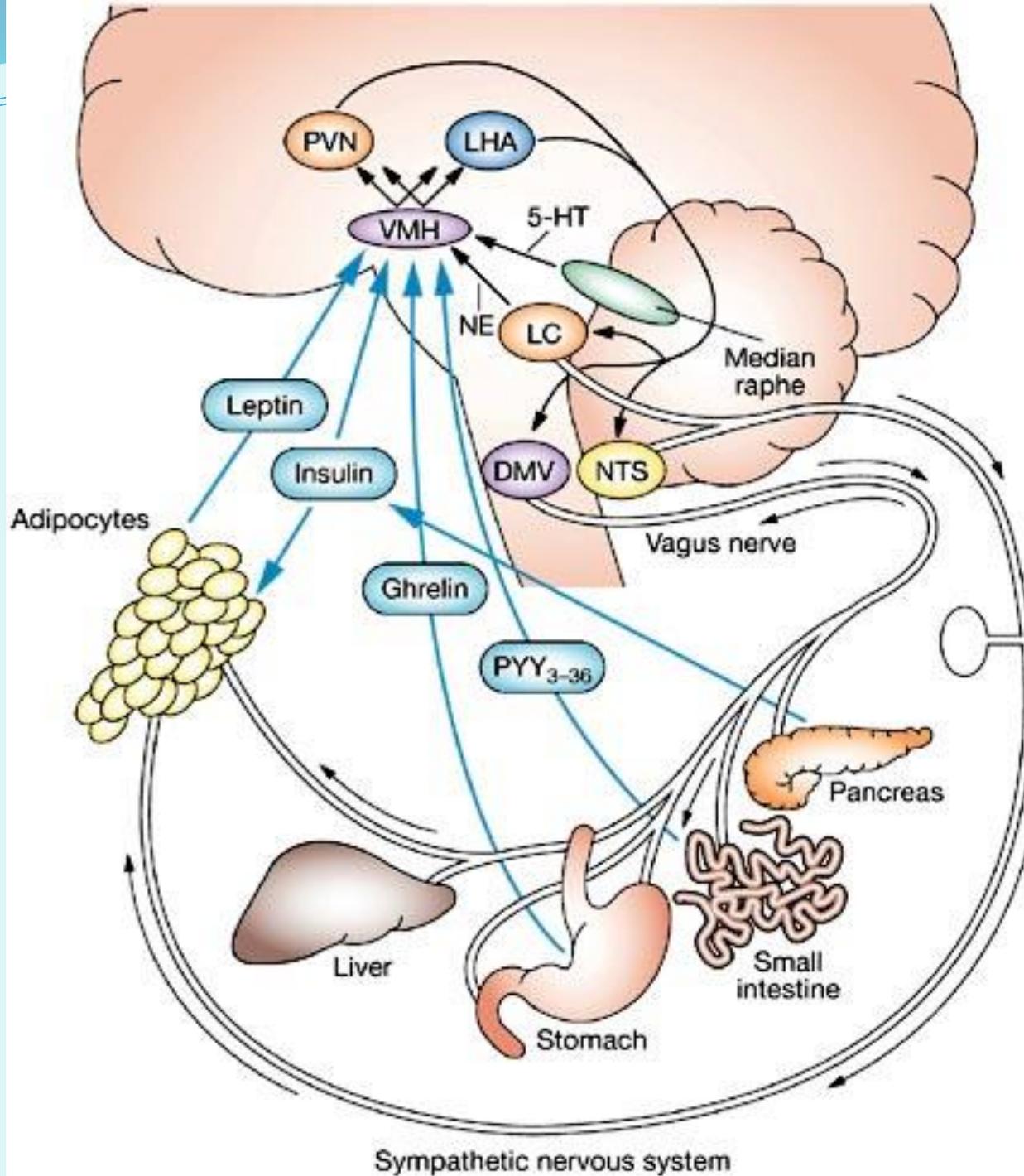
α -MSH
POMC
CART

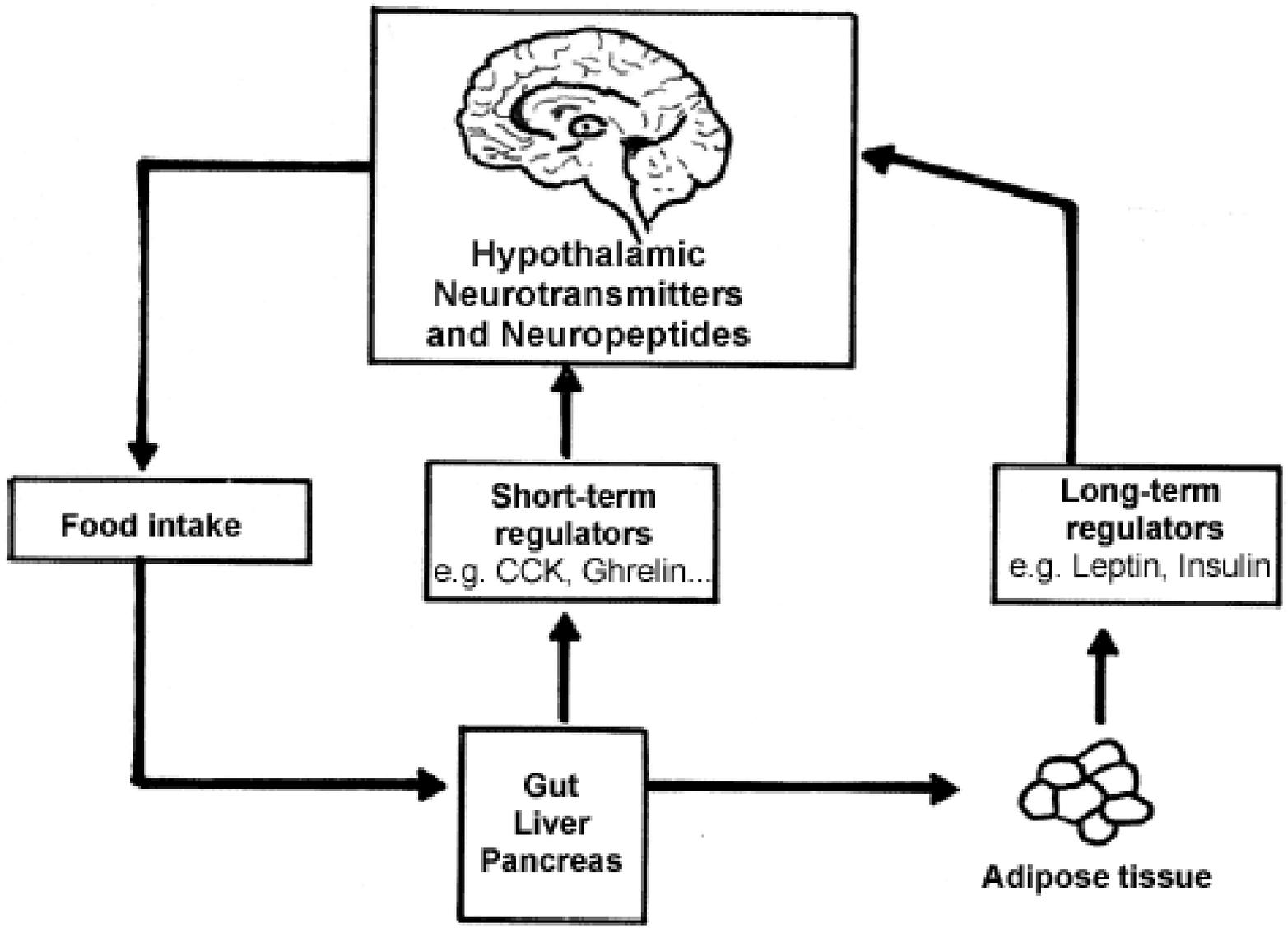
Arcuate nucleus

(+)

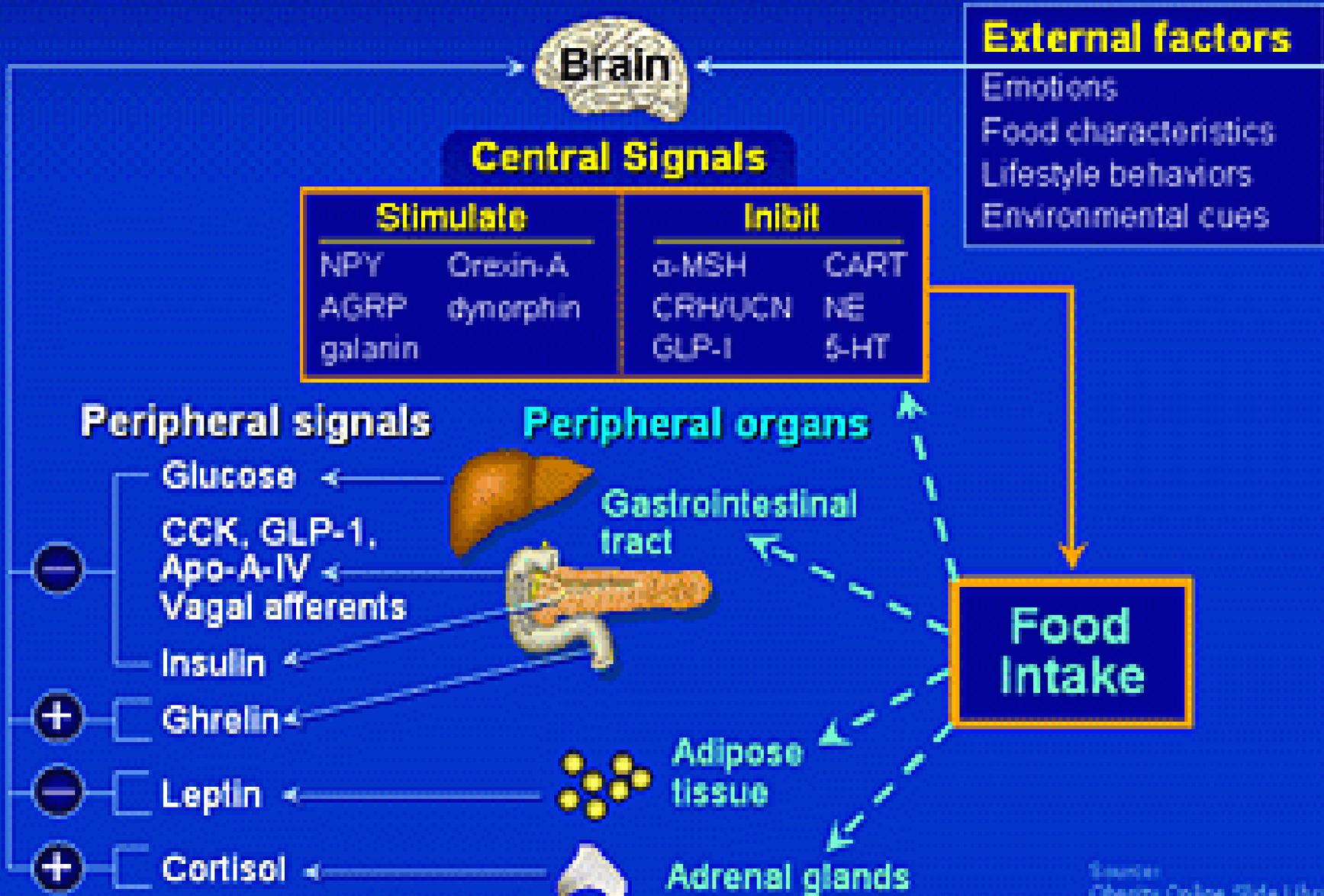
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Gut signaling peptides





Regulation of Food Intake



Regulation of food intake

Long term regulations

Glucostatic theory of hunger and feeding regulation:

Lipostatic theory: Leptin

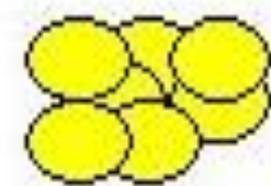
Aminostatic theory:

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

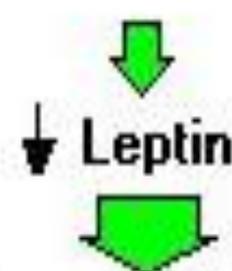
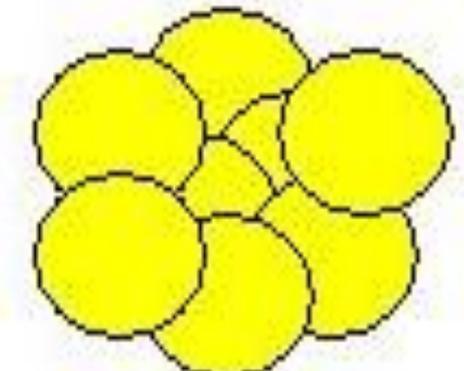
Psychosocial factors:



Weight Loss
←



Weight Gain
→



Increased food intake
Decreased energy expenditure



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

- Positive balance



OBESITY

Causes of obesity

Neurogenic abnormalities:

Genetic factors:

Psychosocial factor:

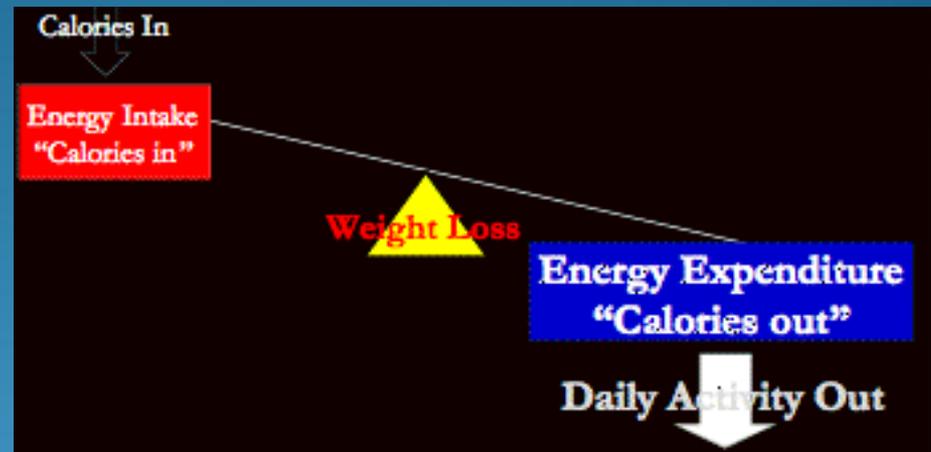
Childhood overnutrition:

Other causes of obesity:

Disorders of the endocrine system
(hypothyroidism) and **lack of physical exercise.**

Inanition

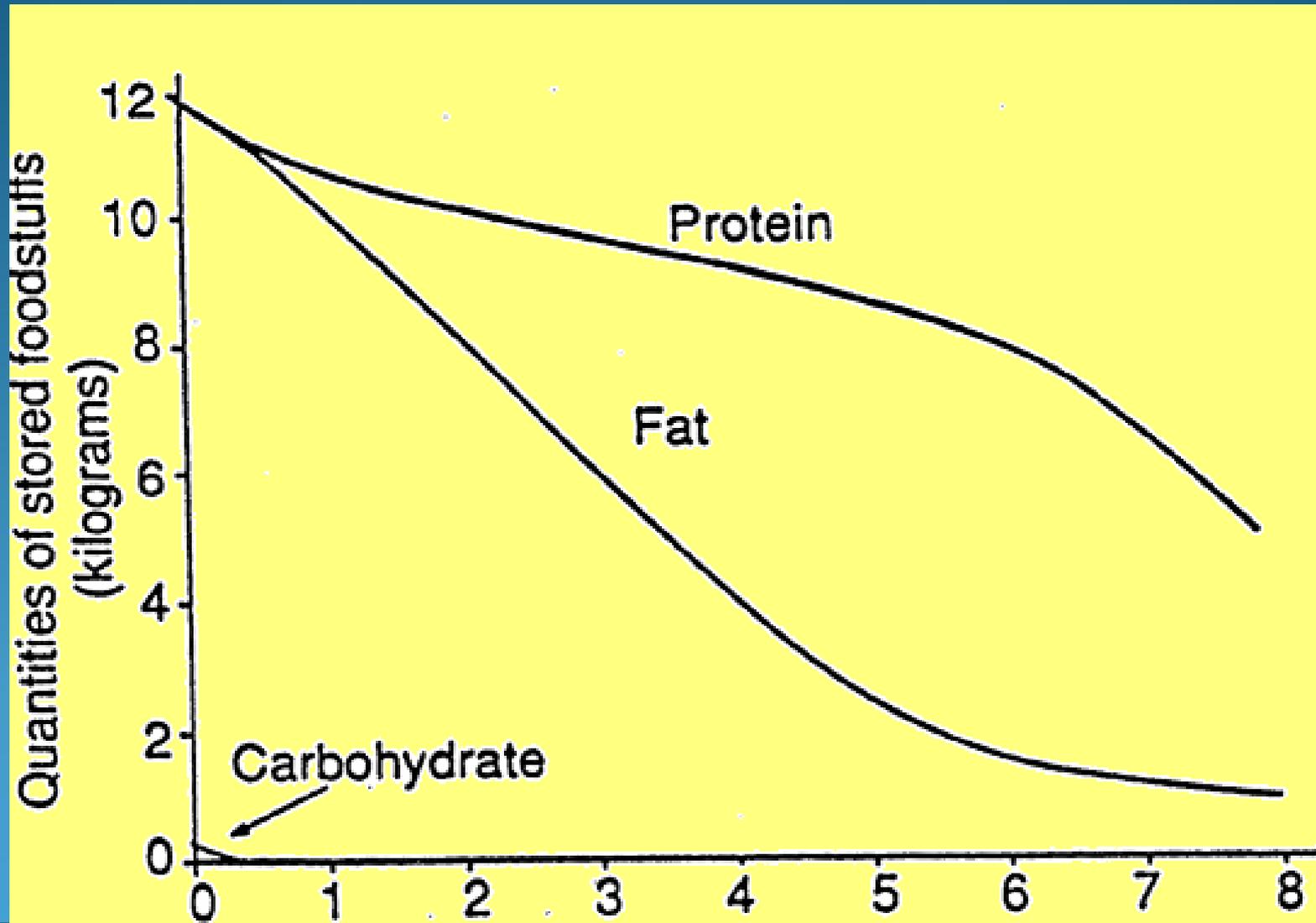
- **Negative balance**



Causes:

psychogenic (anorexia nervosa) or
hypothalamic abnormalities

Starvation and depletion of stores in the body



GOOD LUCK

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