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

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)

2-3 servings

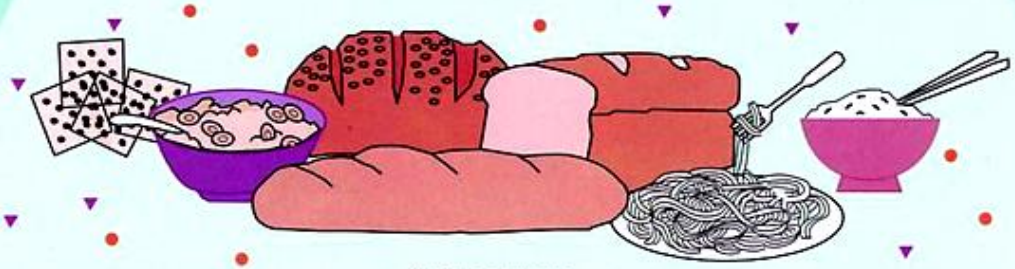
VEGETABLE GROUP
Examples:
- 1 cup raw leafy vegetables
- 1/2 cup other vegetables
- 3/4 cup vegetable juice

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

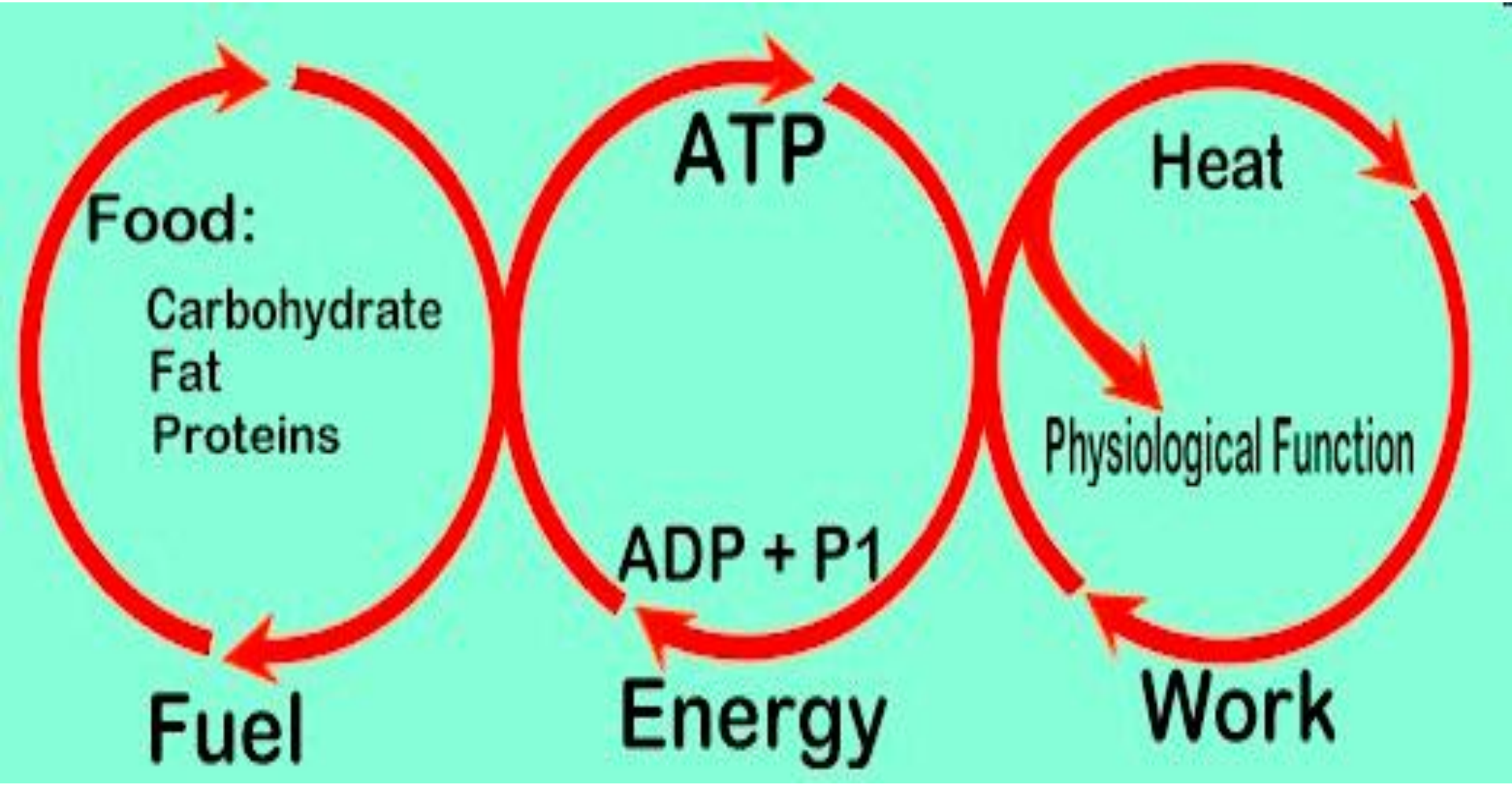
3-5 servings

BREAD, CEREAL, RICE, & PASTA GROUP
Examples:
- 1 oz ready-to-eat cereal
- 1/2 cup cooked cereal, pasta or rice
- 1 slice bread



6-11 servings

The Food Guide Pyramid, Fig# 25.18

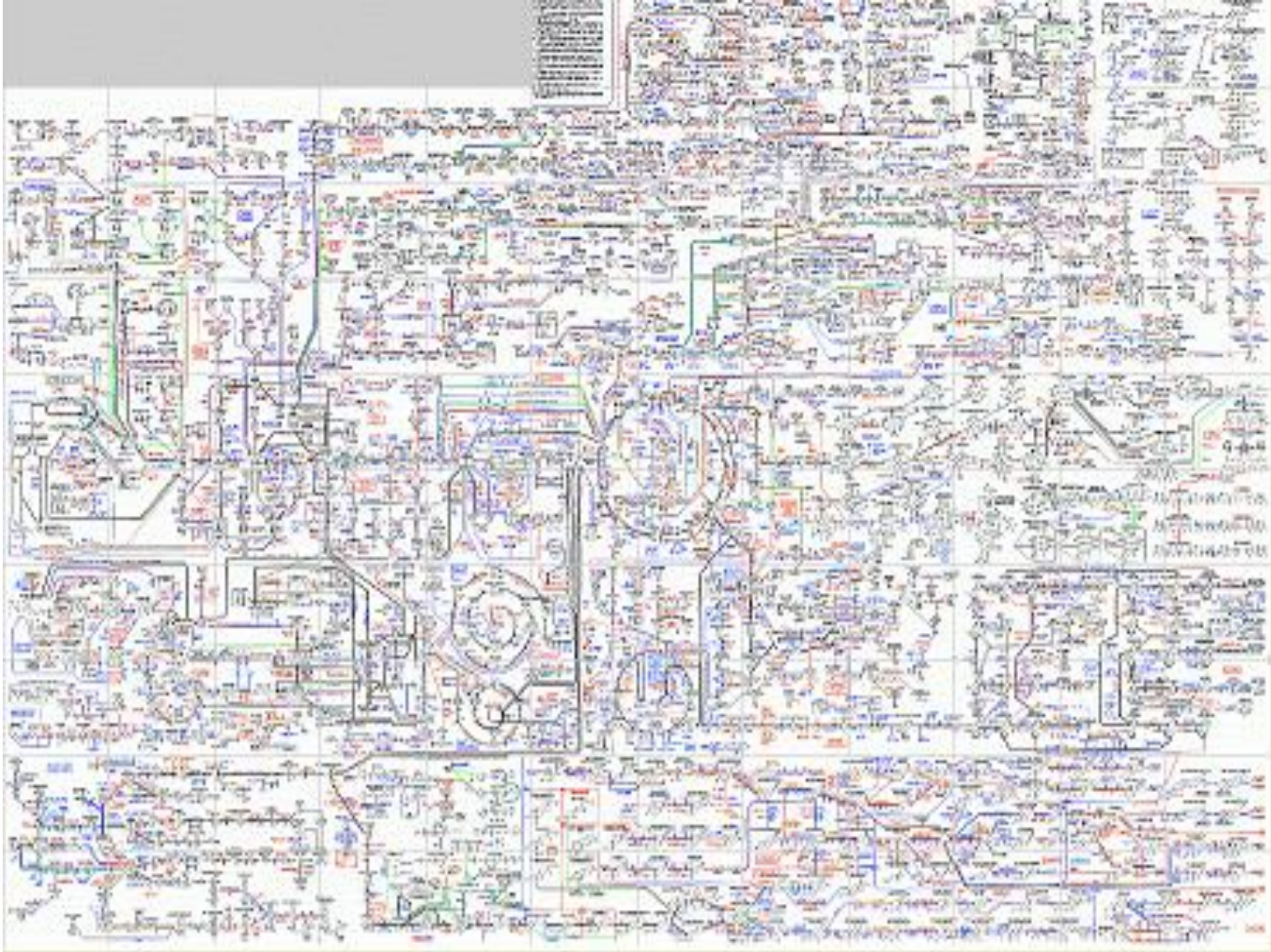

Food:
Carbohydrate
Fat
Proteins
Fuel
ATP
ADP + P1
Energy
Heat
Physiological Function
Work

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).



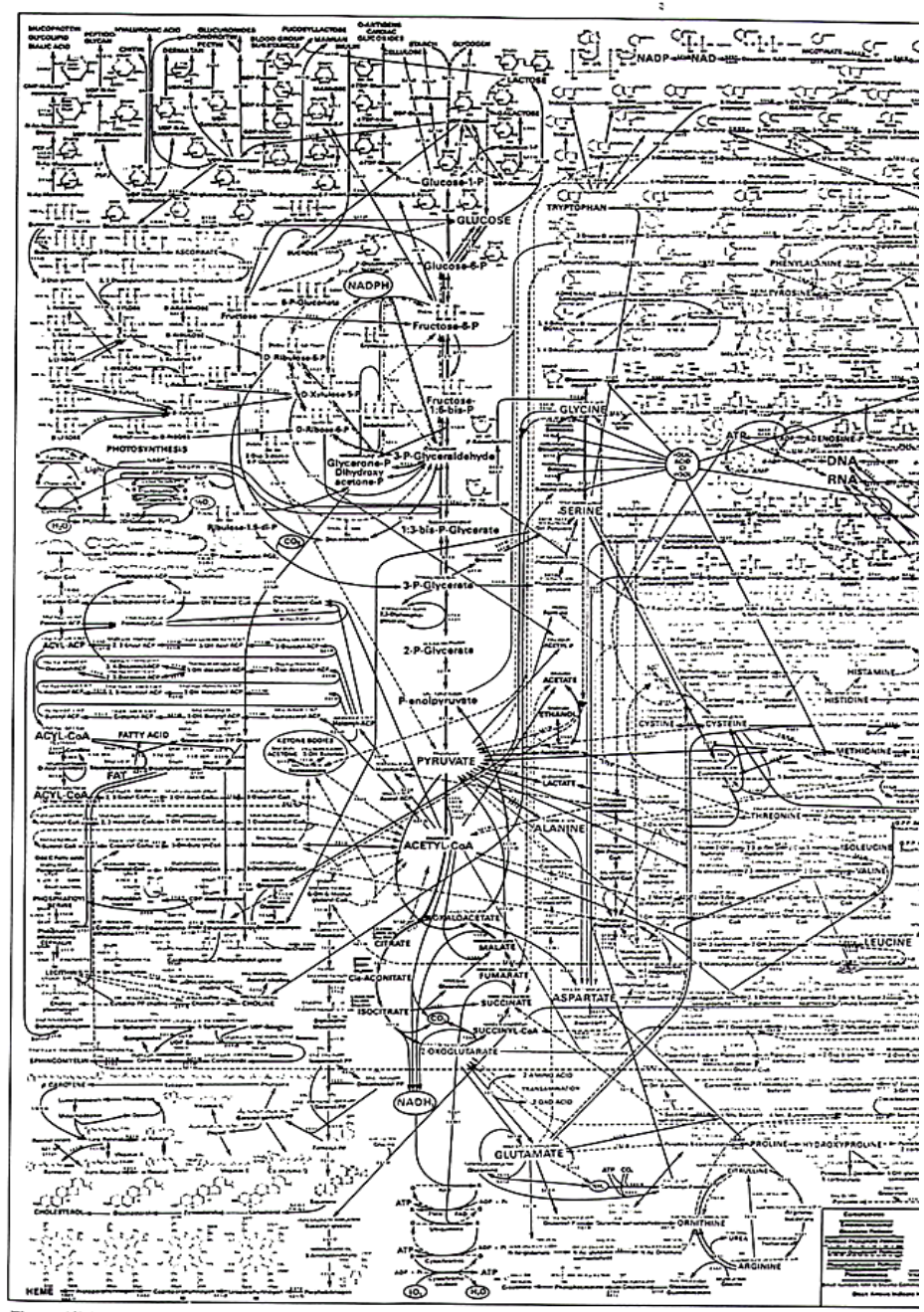
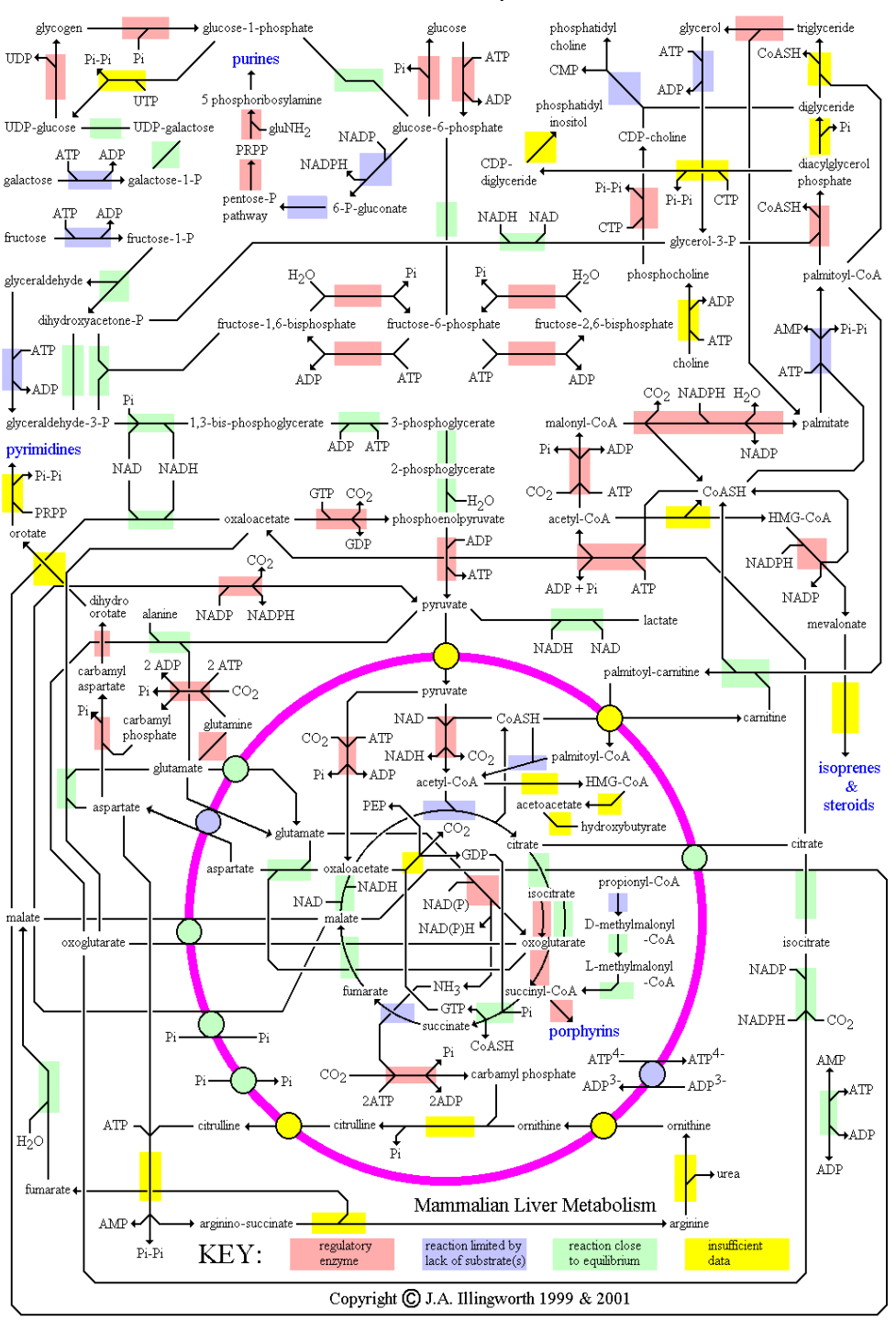
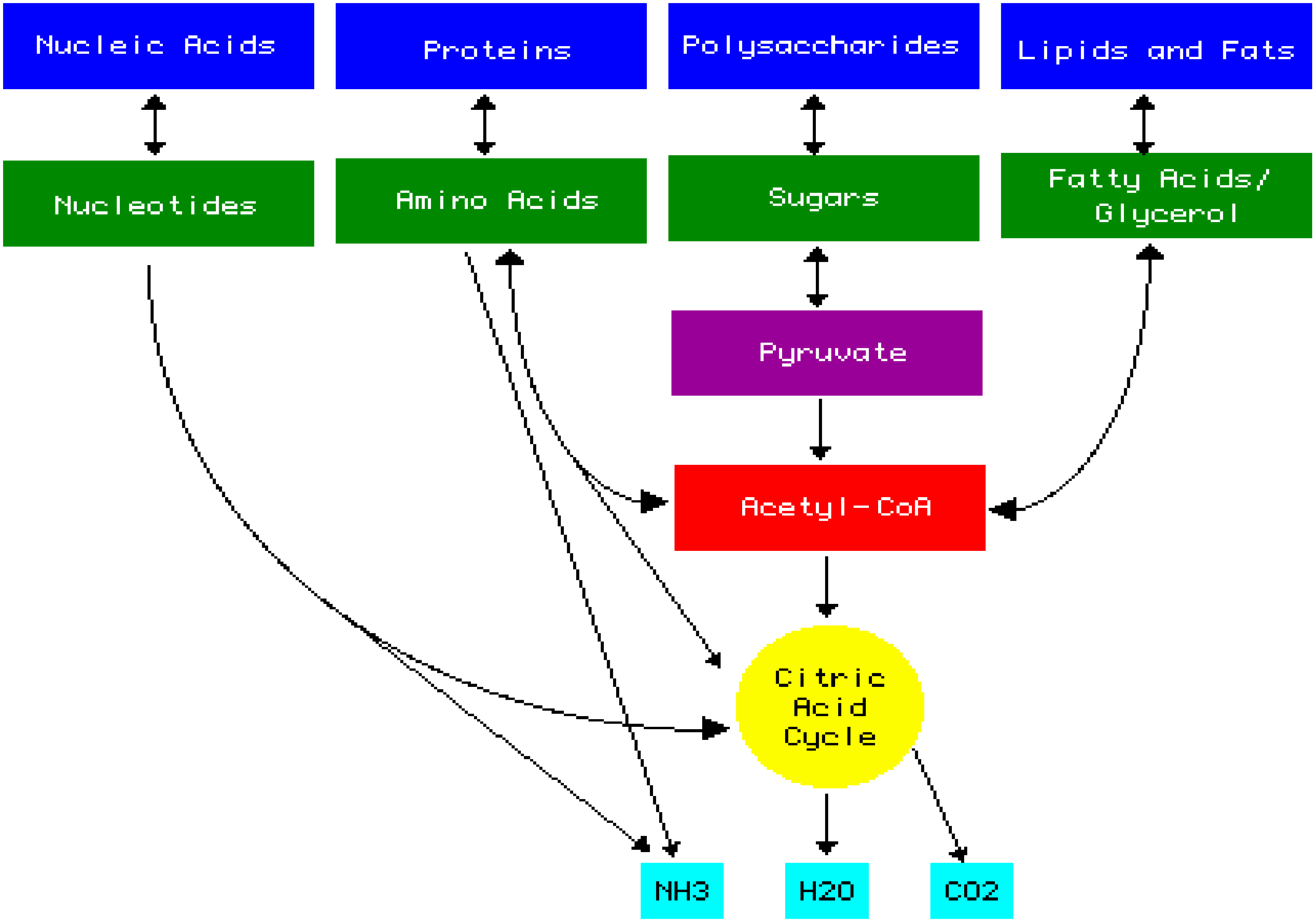
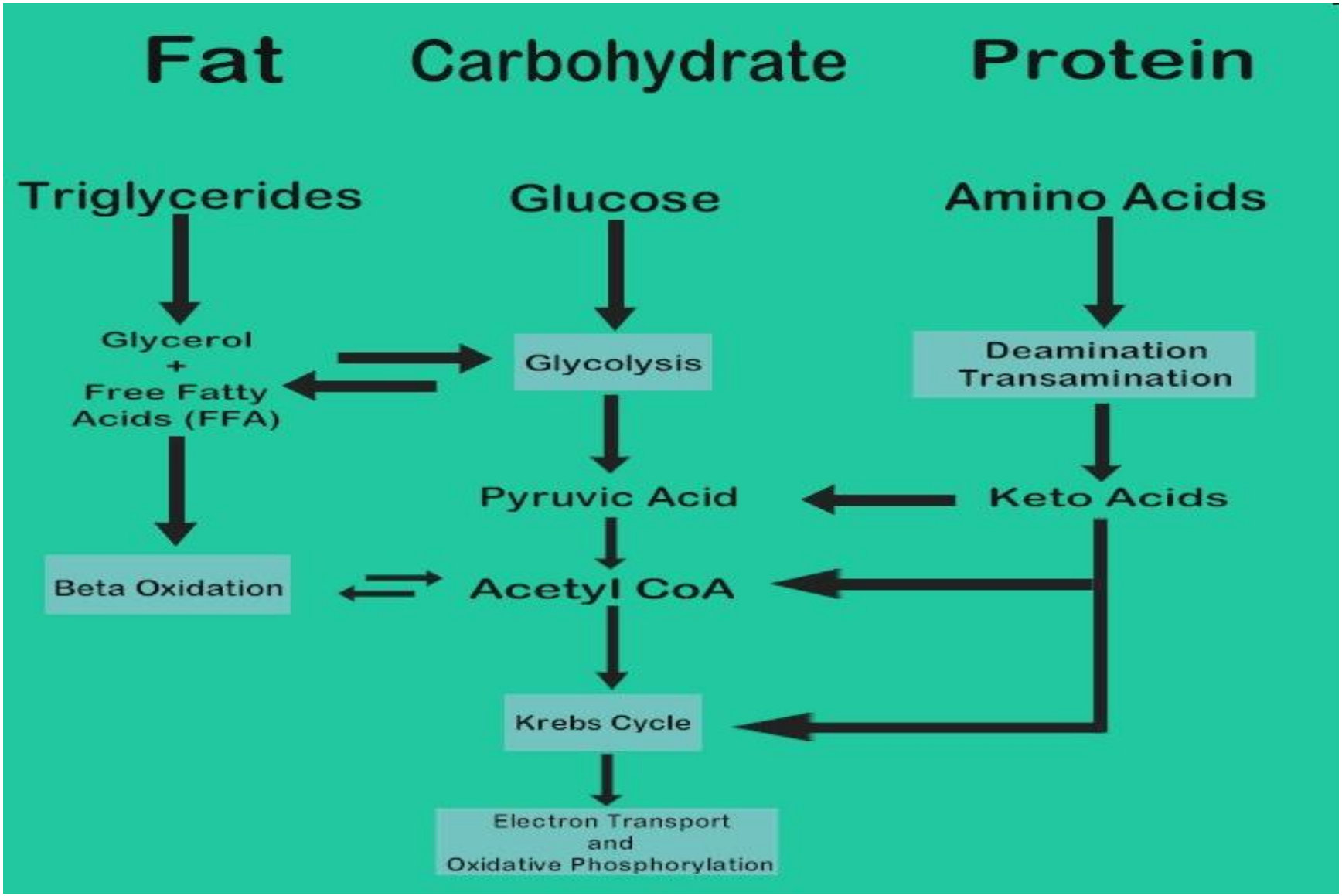


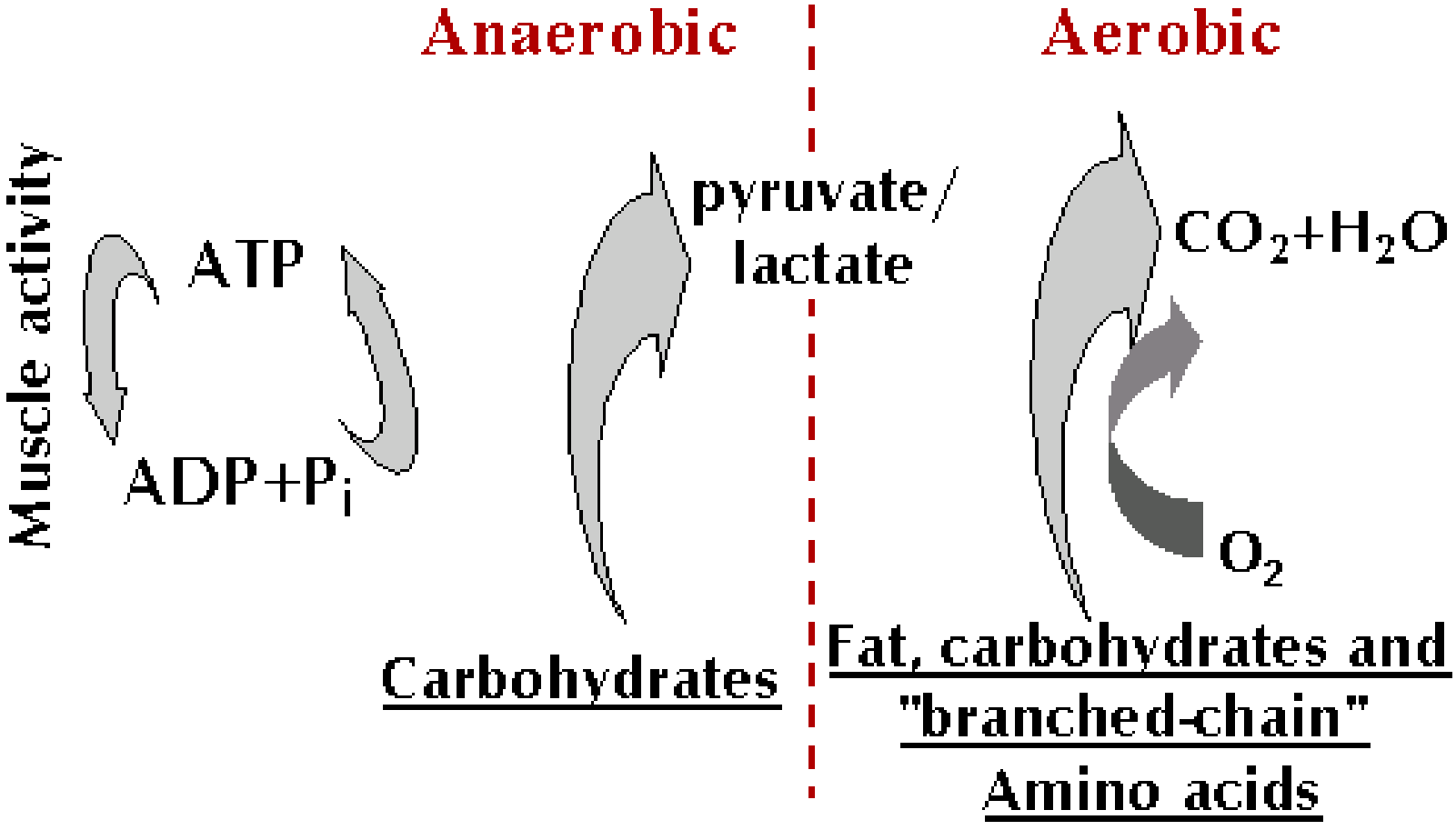
Figure 17.1 A metabolic map, indicating the reactions of intermediary metabolism and the enzymes that catalyz different chemical intermediates, or metabolites, and a greater number of enzymes are represented here.
(Courtesy of D. E. Nicholson, University of Leeds, U.K., and the Sigma Chemical Co.)




Nucleic Acids
Proteins
Polysaccharides
Lipids and Fats
Nucleotides
Amino Acids
Sugars
Fatty Acids/
Glycerol
Pyruvate
Acetyl-CoA
Citric
Acid
Cycle
NH3
H2O
CO2


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



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

Metabolic Rate

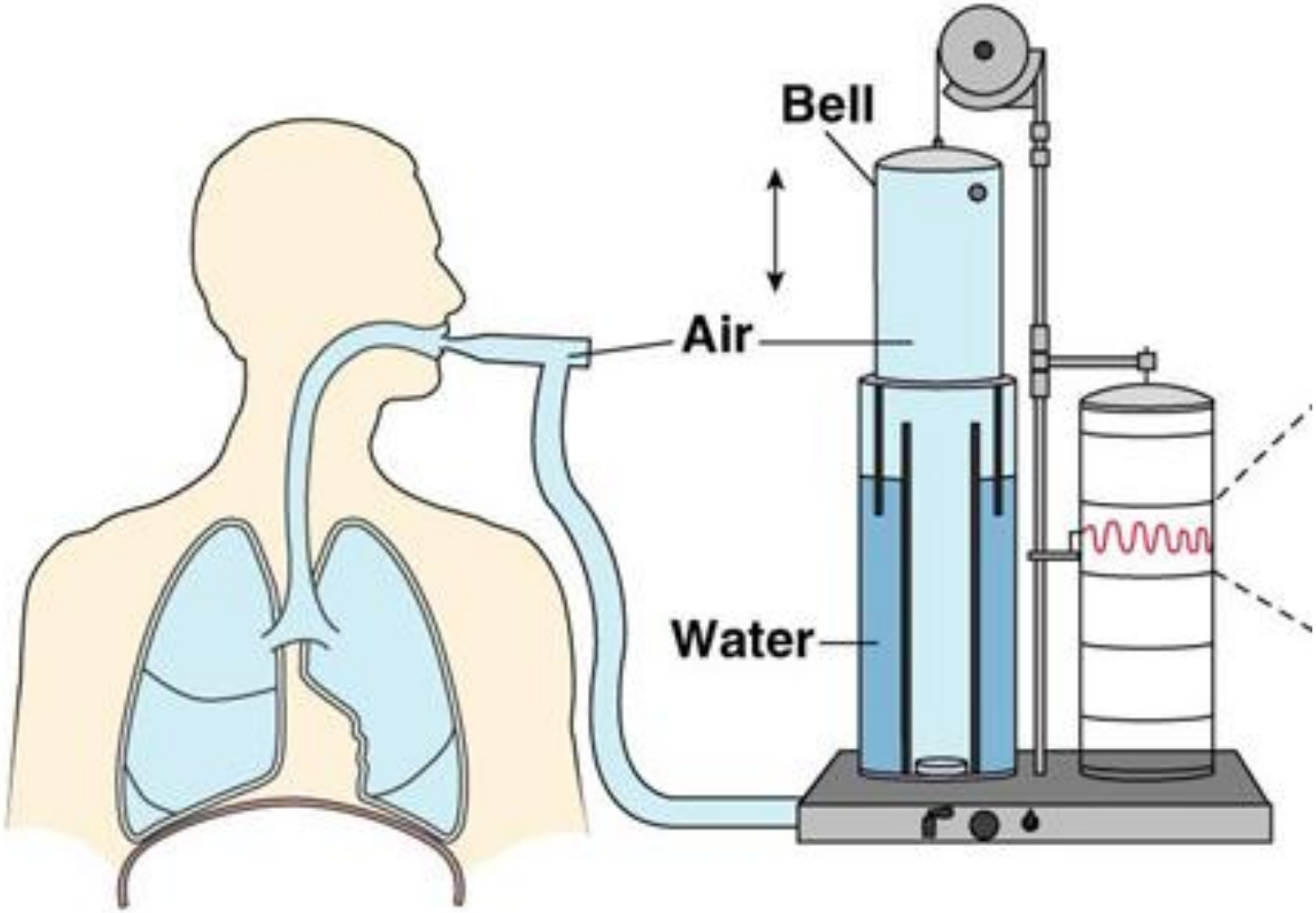
Measurements:

- Direct Calorimetry

- Indirect Calorimetry

(O_2 consumption)

- Closed method
- Opened method


Bell
Air
Water

Basal Metabolic Rate (BMR)

measurement under basal conditions

Basal Conditions

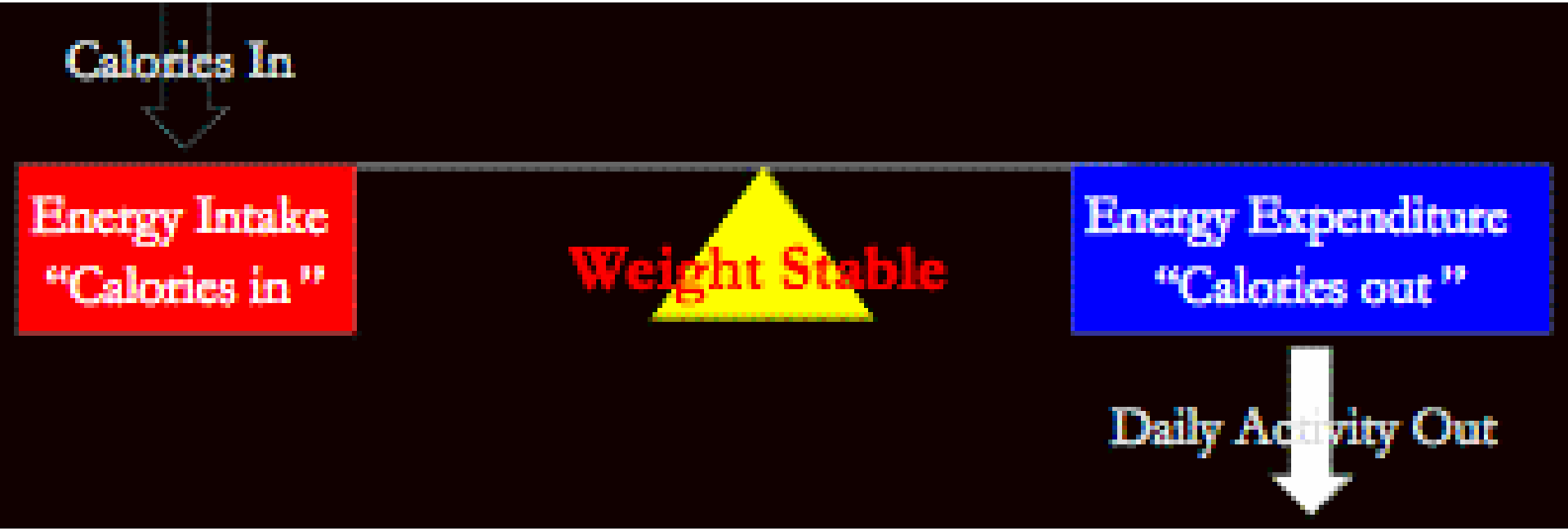
- No eaten food for at least 12 hours.
- Measurement after a night of restful sleep.
- No exercise in the hour prior to the test

Factors affecting metabolic rate

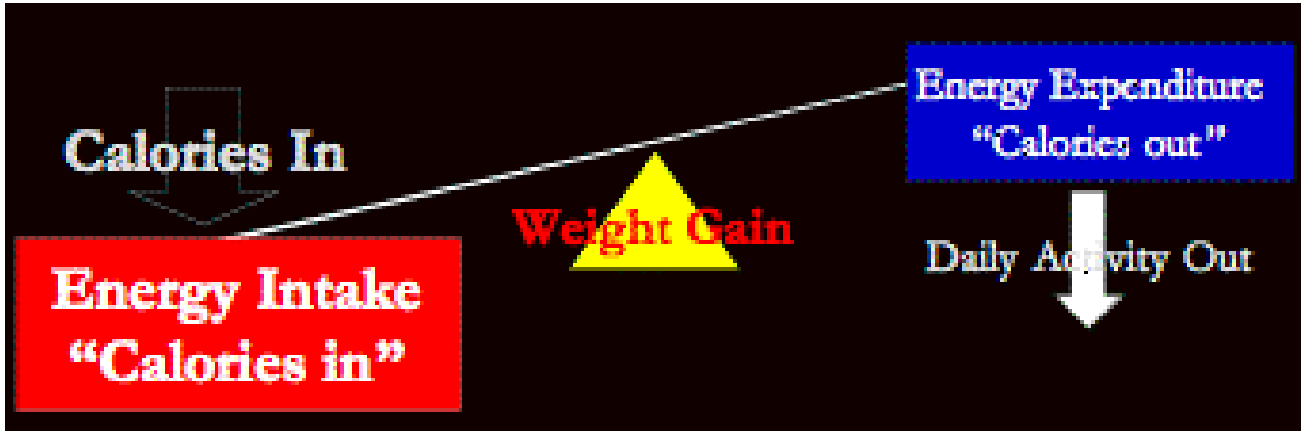
- **Exercise**: increases
- **Daily activities**
- **Age**:
- **Sleep**:
- **Climate**:
- **Fever**:
- **Malnutrition**;
- **Specific dynamic action:**
- **Effect of hormones:**
  Thyroid hormones:
  Male sex hormones increase 10-15%.
  Growth hormones: Increase 15-20%
- **Effect of sympathetic stimulation**: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

Regulation of food intake

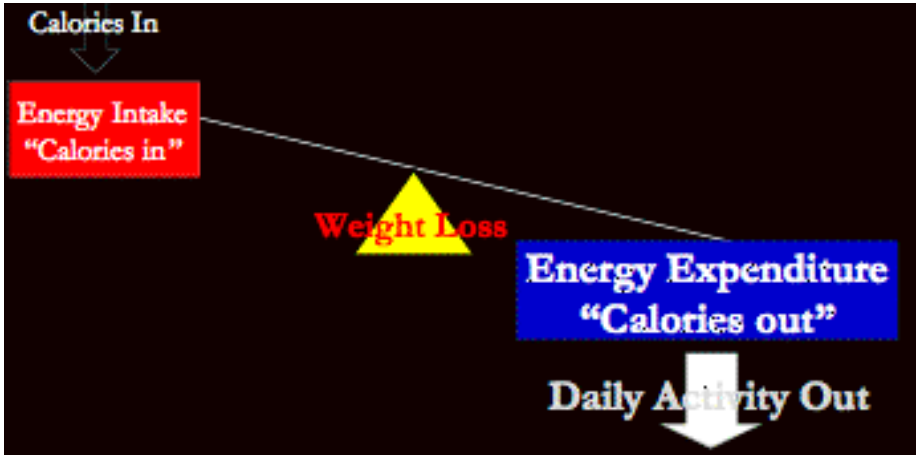
Food intake = Energy expenditure



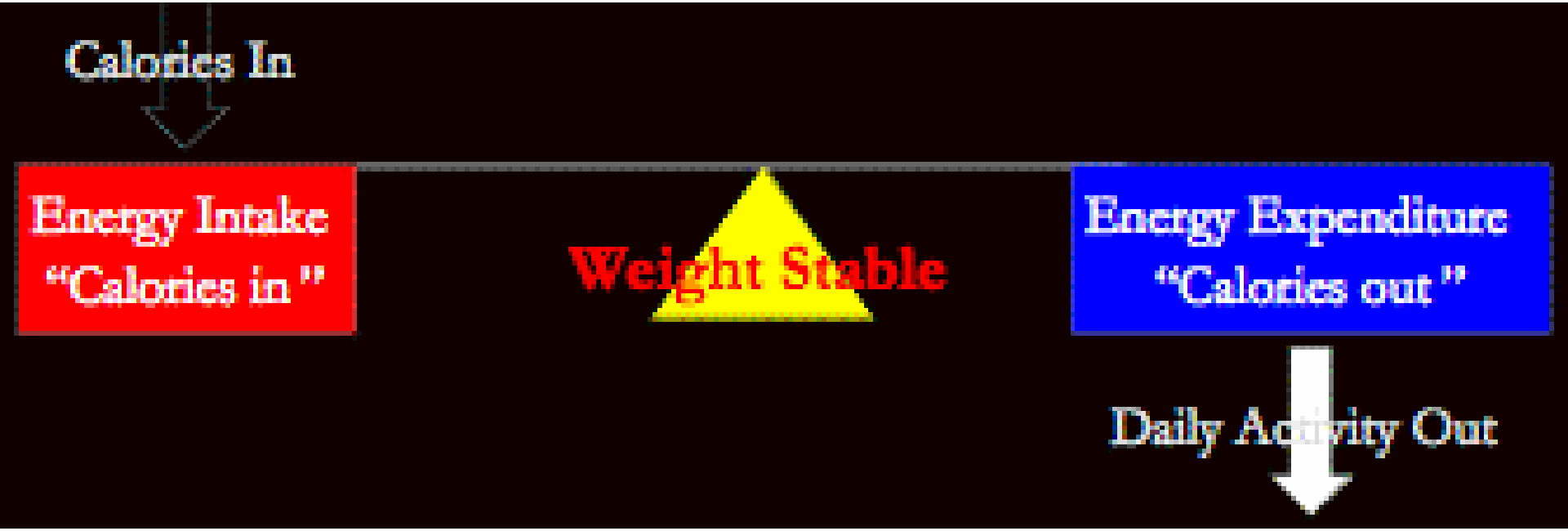
Positive balance



Negative balance



Food intake = Energy expenditure



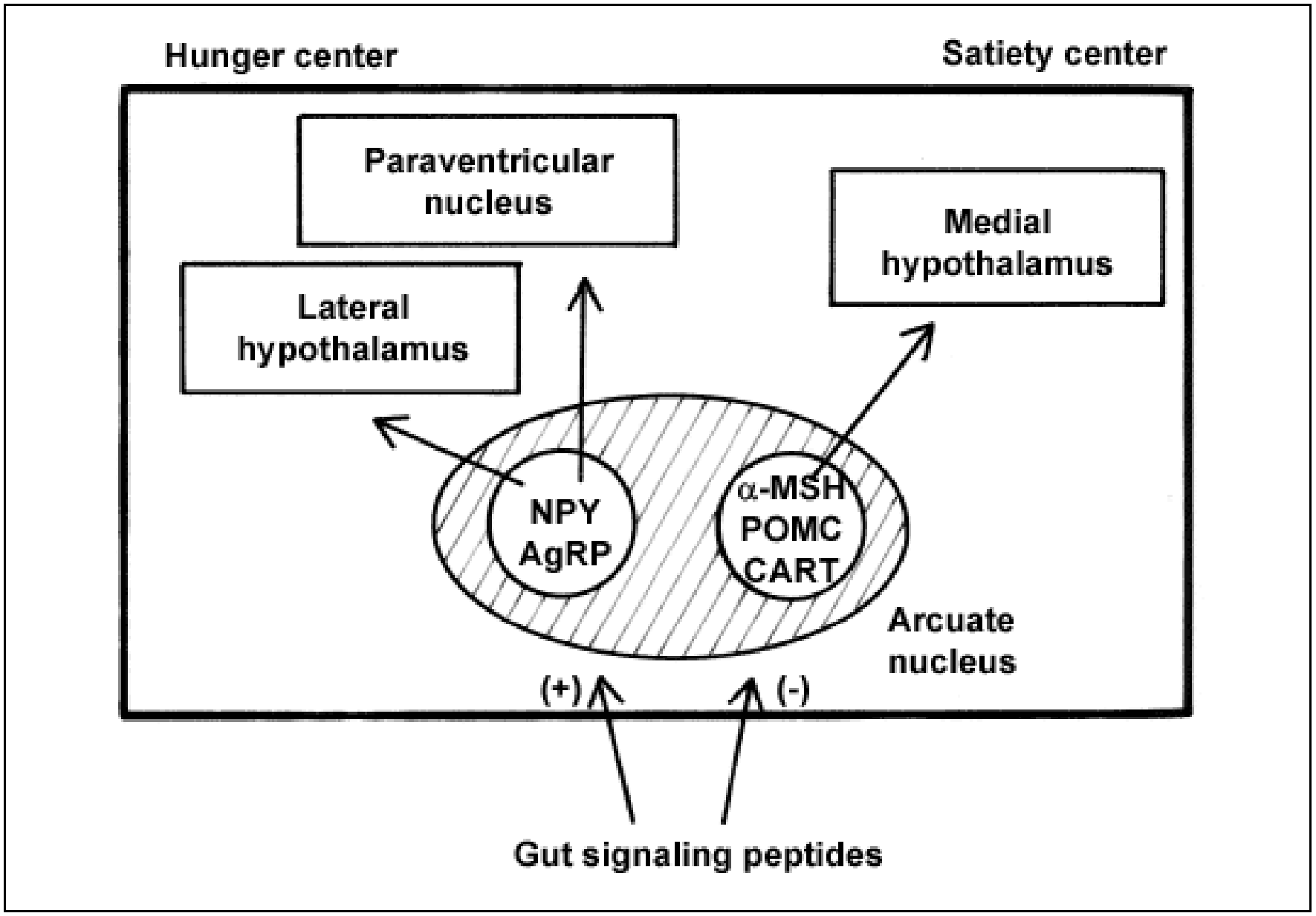
Hypothalamic control of food intake

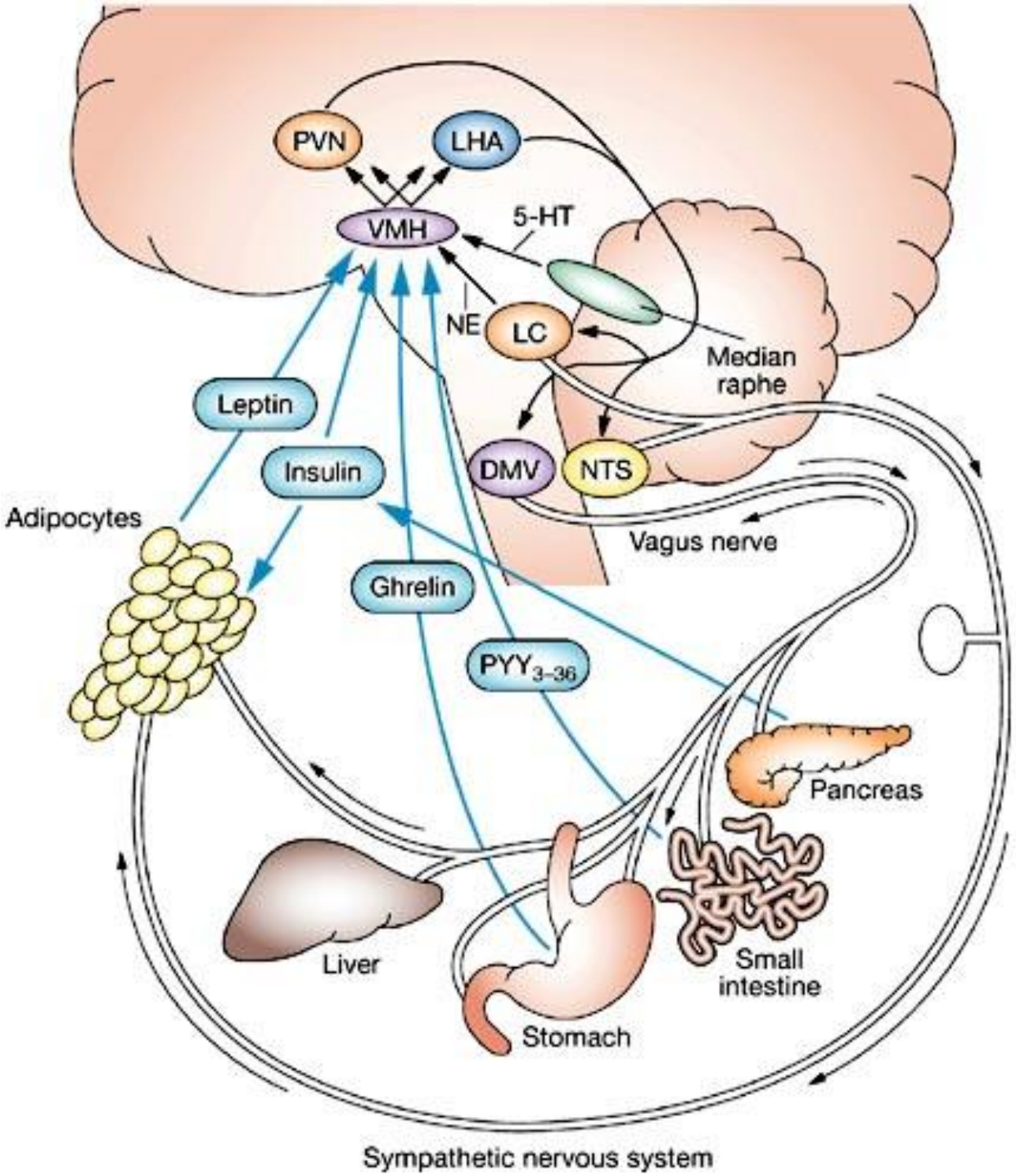
Feeding center: lateral nuclei..

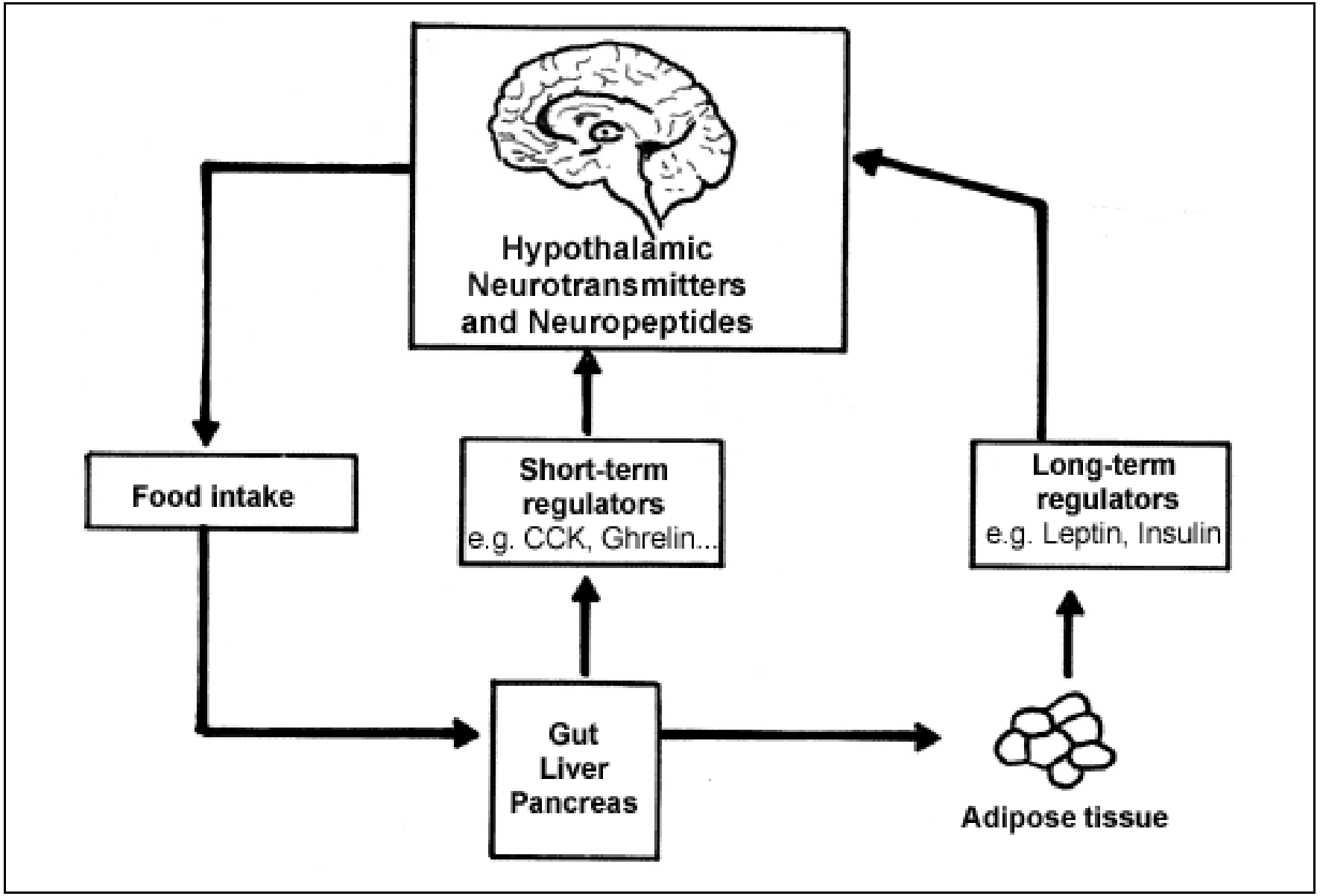
Satiety center: ventromedial nuclei

Amygdala (destruction → psychic blindness.

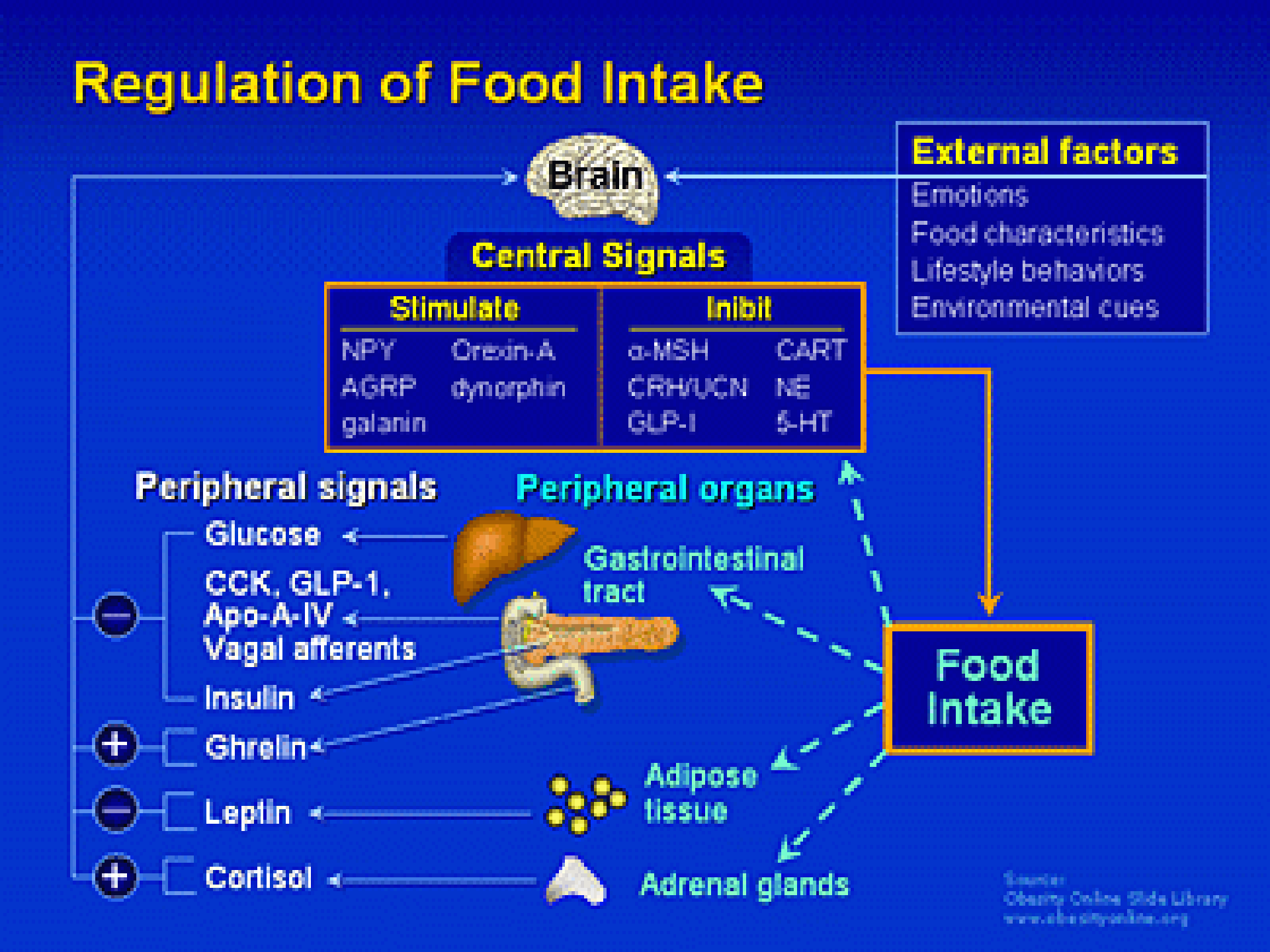
prefrontal cortex:


Hunger center
Satiety center
Paraventricular nucleus
Medial hypothalamus
Lateral hypothalamus
NPY
AgRP
α-MSH
POMC
CART
Arcuate nucleus
(+)
(-)
Gut signaling peptides


PVN
LHA
VMH
5-HT
NE
LC
Median raphe
Leptin
Insulin
DMV
NTS
Adipocytes
Vagus nerve
Ghrelin
PYY3–36
Pancreas
Liver
Small intestine
Stomach
Sympathetic nervous system


Hypothalamic
Neurotransmitters
and Neuropeptides
Food intake
Short-term
regulators
e.g. CCK, Ghrelin...
Long-term
regulators
e.g. Leptin, Insulin
Gut
Liver
Pancreas
Adipose tissue

Regulation of Food Intake



Regulation of food intake

Long term regulations

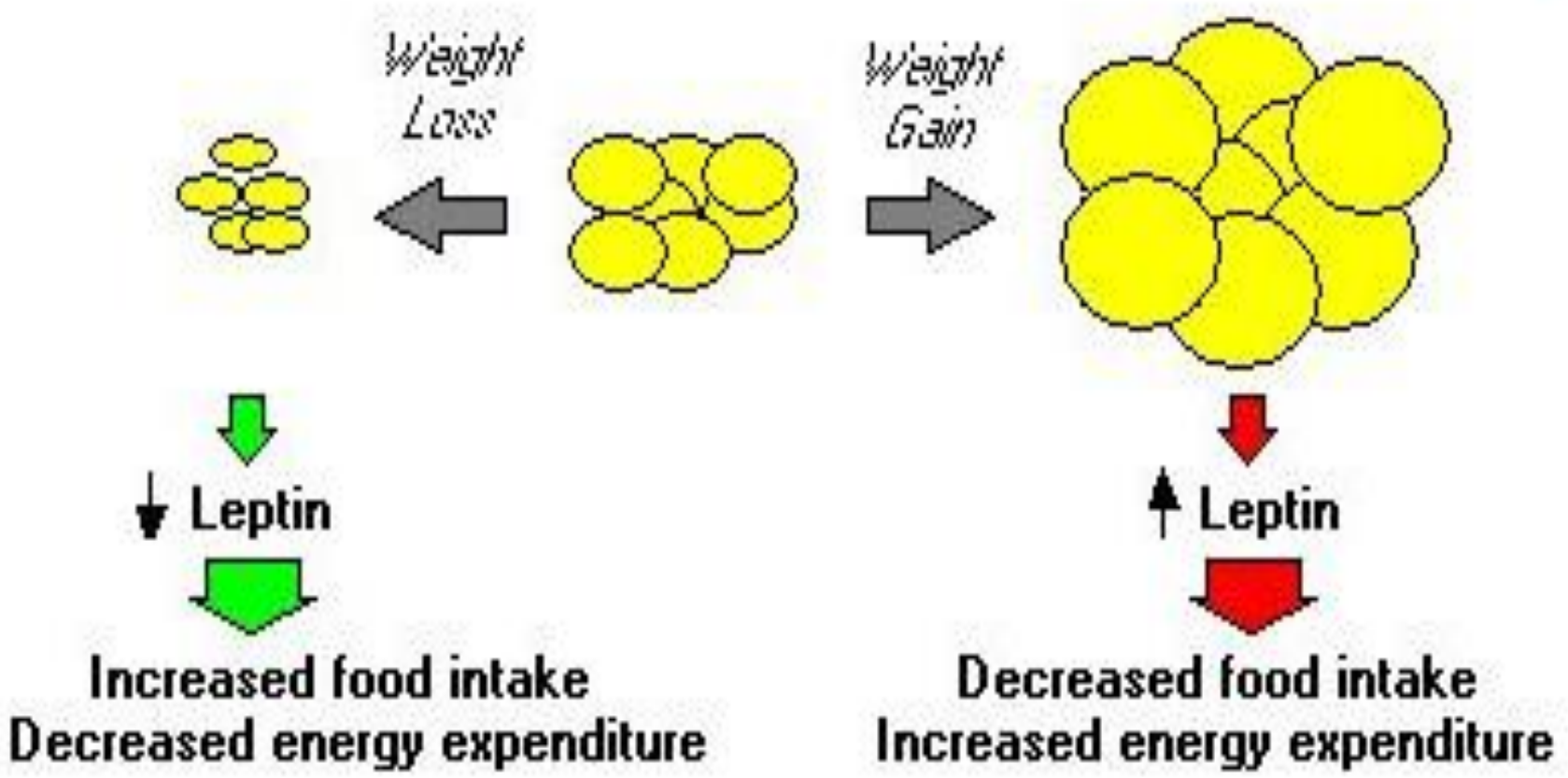
Glucostatic theory of hunger and feeding regulation:

Lipostatic theory: Leptin

Aminostatic theory:

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

Psychosocial factors:


Weight Loss
Weight Gain
Leptin
Leptin
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

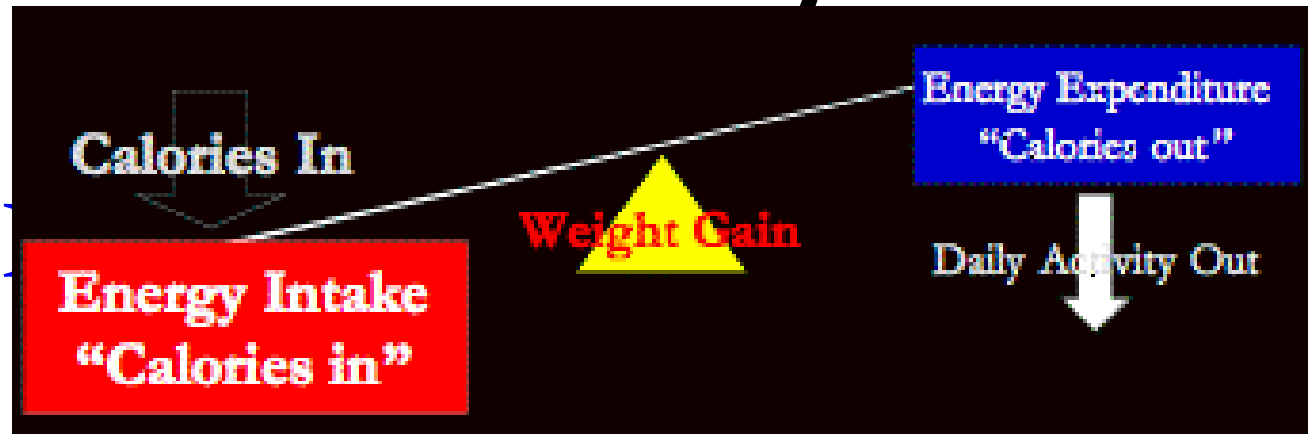
These are rapid signals that affect feeding.

Gastrointestinal filling:

Hormonal factors:

Suppression by oral receptors:

Obesity


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:

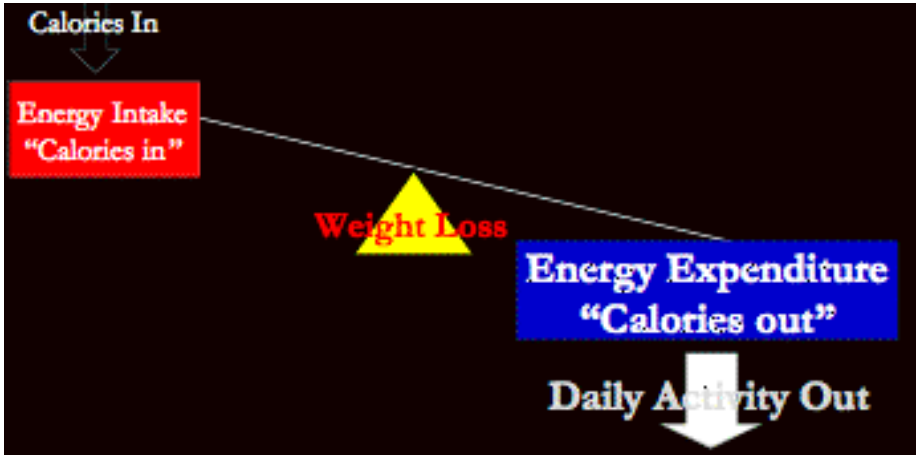
Childhood overnutrition:

Other causes of obesity:

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

Inanition

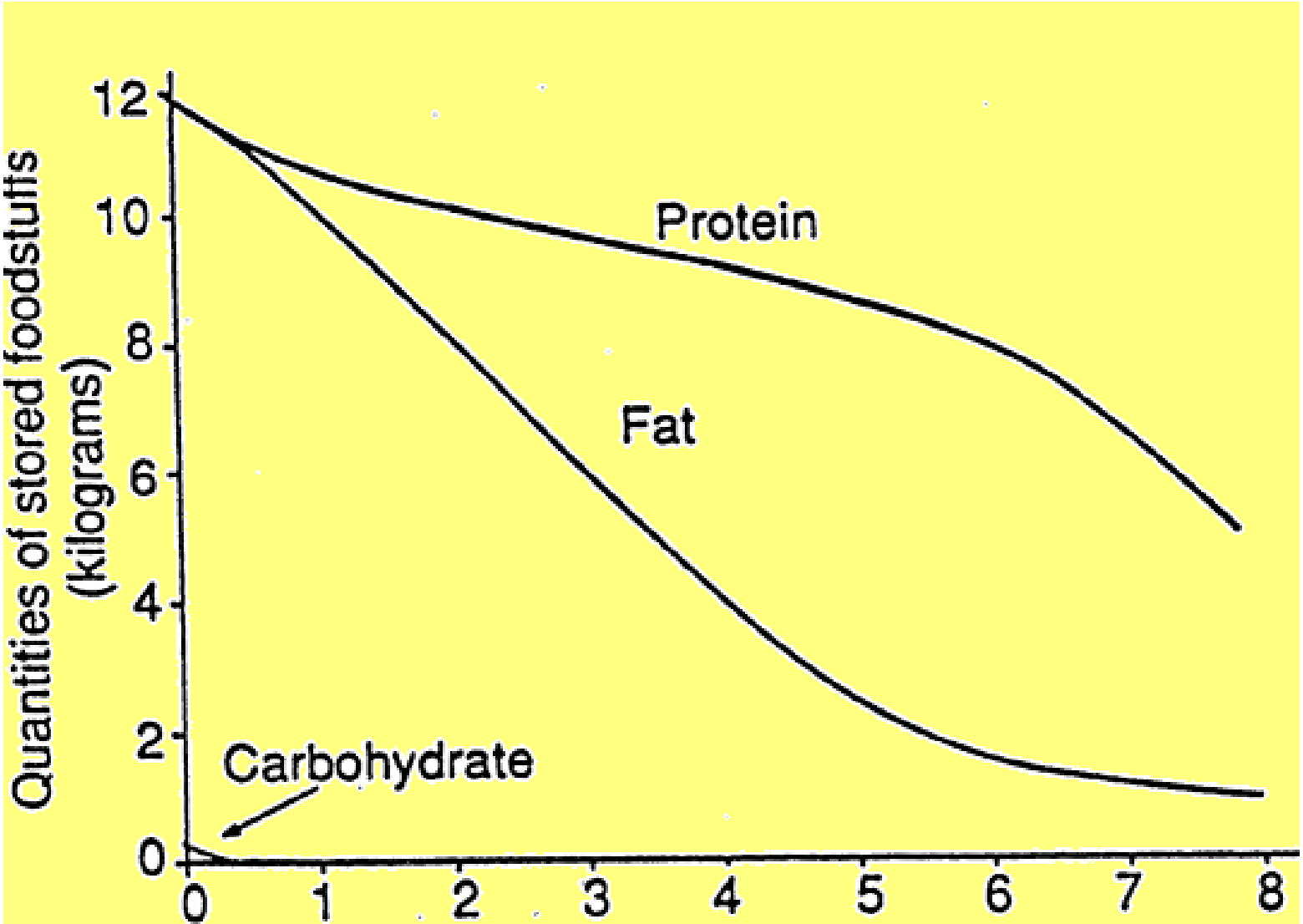
Negative balance



Causes:

psychogenic (anorexia nervosa) or hypothalamic abnormalities

Starvation and depletion of stores in the body




GOOD LUCK
E-mail: malessa@ju.edu.jo