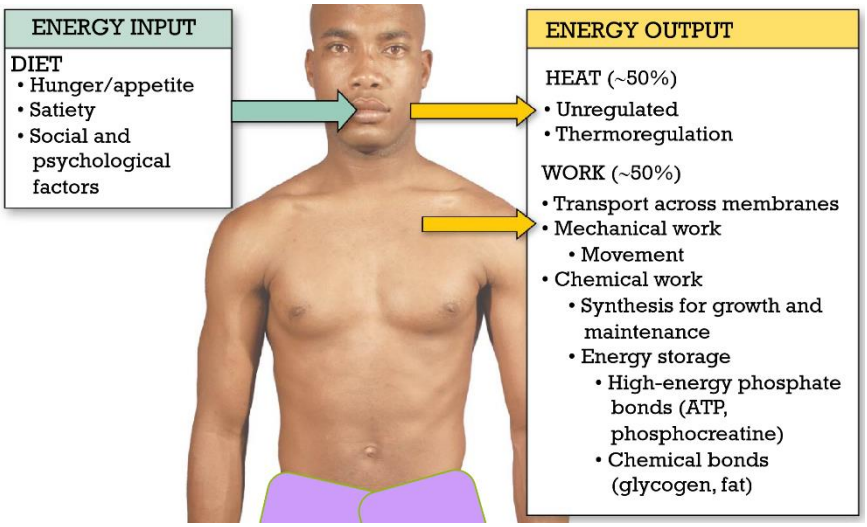
NUTRITION

ENERGY REQUIREMENTS OF THE BODY

What are the energy requirements of the body?

- Energy is not a nutrient
- But is required in the body for metabolic processes, physiologic functions, muscular activity, heat production, growth and synthesis of new tissues
- It is released from food components by oxidation
- We need:
    - **Macronutrients**
        - Carbohydrates (e.g., grains, potatoes, sugars, bread)
        - Proteins (e.g., meat, fish, chicken, eggs, soy, milk)
        - Fats/lipids (e.g., oils, butter, margarine)
    - **Micronutrients**
        - Vitamins (e.g., fruit, veg, meat, liver, milk)
        - Minerals (e.g., milk, meat, fruit, veg, supplements)
    - **Water**



We can apply the concept of mass balance to energy balance

- Changes to the body's energy stores result from the difference between the energy input and energy used

TOTAL BODY ENERGY = STORED ENERGY + ENERGY INTAKE – ENERGY OUTPUT

- Energy intake: from the nutrients we consume
- Energy output: combination of work performed, and heat lost

ENERGY OUTPUT = WORK + HEAT

- At least half of our energy released in chemical reactions is lost as waste

Work…takes one of three forms

- Transport work
    - Molecules over a membrane
    - Materials in and out of the body and their transfer between compartments
- Mechanical work
    - Uses intracellular fibres and filaments to create movement
    - Includes
        - External work – movement by skeletal muscle

        - Internal work – movement of cytoplasmic vesicles
- Chemical work
    - Used for growth, maintenance, storage of information & energy
    - Subdivided into synthesis and storage
        - **Short term energy** is stored in high-energy phosphate compounds such as **ATP**
        - **Long-term energy** is stored as chemical bonds of **glycogen** and **fat**
- Most of energy-consuming work – unconscious
- We can voluntarily increase energy output - body movement
- Energy intake can be controlled
    - Excess – weight gain -> obesity
    - Insufficient – weight loss -> malnutrition

ENERGY INTAKE CAN BE ESTIMATED

Energy intake (consumption of food) and energy output (expenditure through heat loss and work)

Direct Calorimetry

Measures the total energy content of food

- Food is burned in an instrument called a bomb calorimeter
- Heat is released, trapped, measured
- The heat released = direct measure of the energy content of the burned food
- Measured in kilocalories (kcal)
    - 1 kilocalorie – a Calorie (C) = the amount of heat needed to raise the temperature of 1 litre of water by 1˚C
- The metabolic energy content of food is slightly less than total energy
    - Most foods cannot be fully digested or absorbed

Indirect Calorimetry

Estimates metabolic rate as a measure of energy expenditure
Oxygen consumption reflects energy use:

- Oxygen consumption
    - The rate at which the body consumes oxygen as it metabolizes nutrients
- Carbon dioxide production
    - Aerobic metabolism consumes O_2 and produces CO_2
- Ratio of CO_2 to O_2
    - The **ratio of CO_2 to O_2 consumed (Respiratory Quotient, RQ** or **Respiratory exchange rate (RER)**
    - RQ/RER varies with the composition of the diet
    - High of 1.0 for a pure carbohydrate diet to 0.8 for a pure protein diet and 0.7 for pure fat

METABOLIC RATE

Metabolic rate is calculated by multiplying oxygen consumption by the number of kilocalories metabolized per litre of oxygen consumed

Metabolic rate = energy expenditure

METABOLIC RATE (KCAL/DAY) = LO_2 CONSUMED/DAY X KCAL/LO_2

- A mixed diet with an RQ of 0.8 requires 1 litre of O_2 for each 4.8 kcal metabolized
- For a 70 kg man with a resting oxygen consumption of 430 L/day
- Resting metabolic rate