NUTRITION

Caloric requirements of the body

And in the earth are tracts (diverse though) neighboring, and gardens of vines and fields sown with corn and palm trees----growing out of single roots or otherwise: watered with the same water, yet some of them We make more excellent than others to eat. Behold, verily in these things there are Signs for those who understand.

4 - Ar Ra'd Al Quran

LECTURE CONTENTS

- Energy requirement
- Units of energy
- Calculating energy expenditure
- Energy content of food
- Metabolic rate
- Energy expenditure for various activities
- Energy balance
- Dietary advice in various disorders

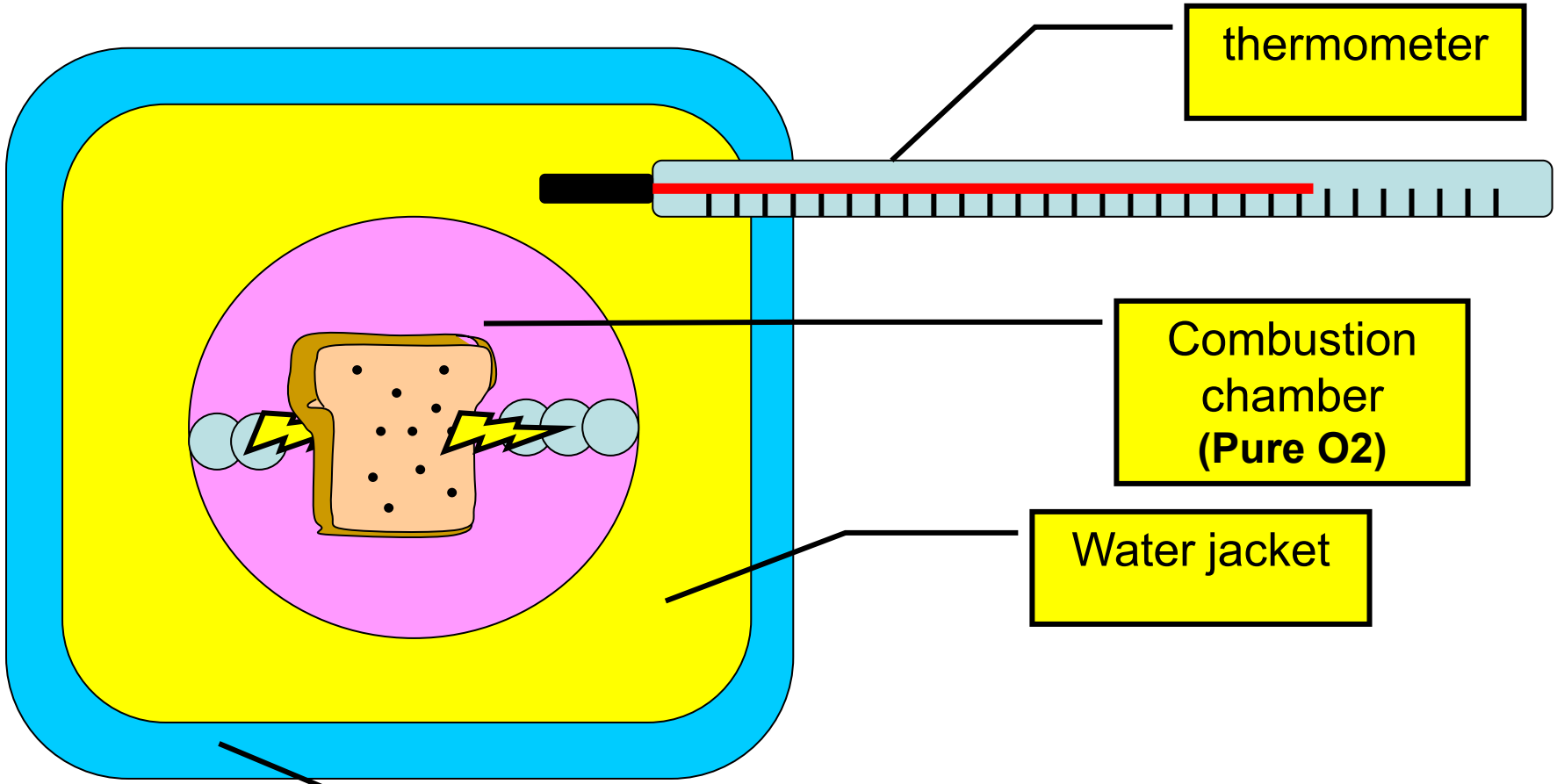
ENERGY REQUIREMENT

- "Number of calories/kJ that must be consumed per day to support growth and maintenance."
- Units of energy
  - Calories
  - Joules
  - 1 watt = 1J/sec

UNITS OF ENERGY

- KILOCALORIE
  - "Amount of heat required to raise the temperature of 1 kilogram of water by 1°C."
    - **1 kilocalorie = 1000 calories**
- KILOJOULE
  - A kilojoule is the energy required to lift a load of 1 kg by 1 meter."
    - **1kJ = 0.239kcal**
    - **1kcal =4.184kJ**

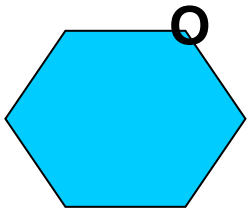
CALCULATING ENERGY EXPENDITURE



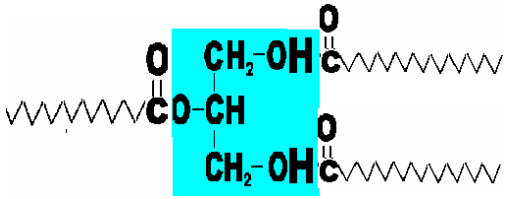
ENERGY CONTENT OF FOOD

CALCULATING ENERGY EXPENDITURE

- Respiratory quotient
  - "the number of CO2 molecules discharged from the body per number of oxygen molecules consumed."
  - CO2/O2



RQ = 1.0



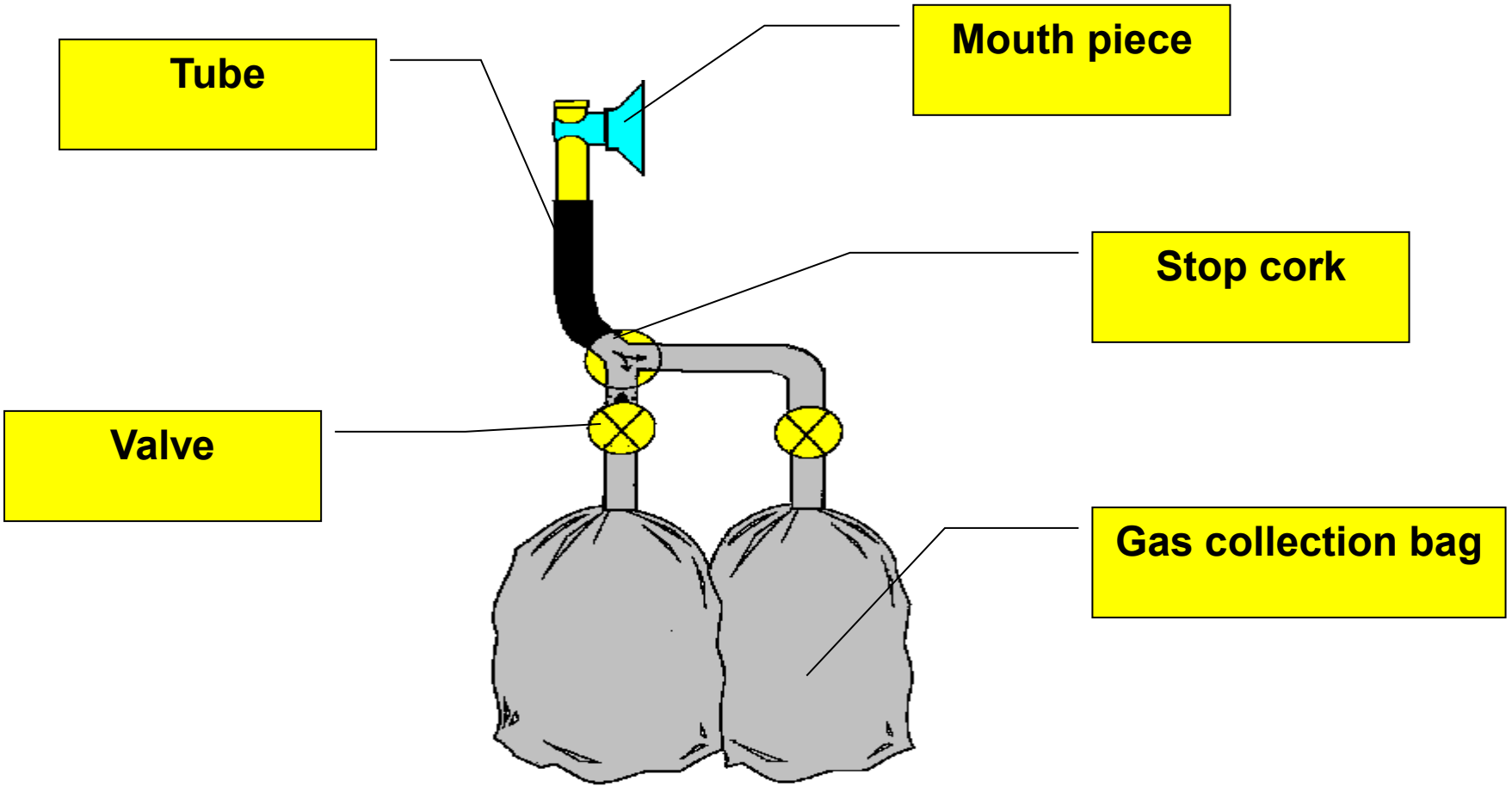
RQ = 0.7

RESPIRATORY QUOTIENT

- Methods to determine RQ
  - Open circuit method
  - Closed circuit method

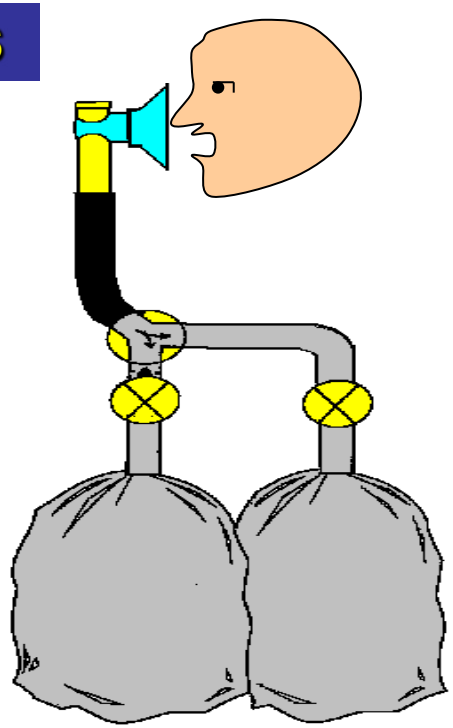
RESPIRATORY QUOTIENT

Douglas bag



OPEN CIRCUIT METHOD TO DETERMINE RQ

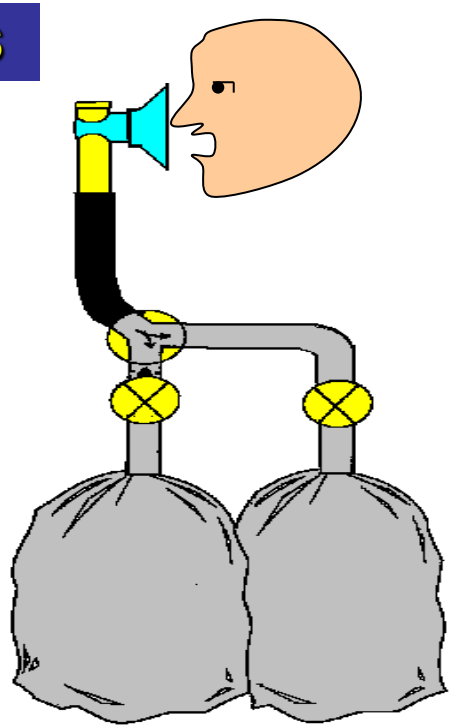
HALDANE GAS ANALYSIS APPARATUS



OPEN CIRCUIT METHOD TO DETERMINE RQ

HALDANE GAS ANALYSIS APPARATUS

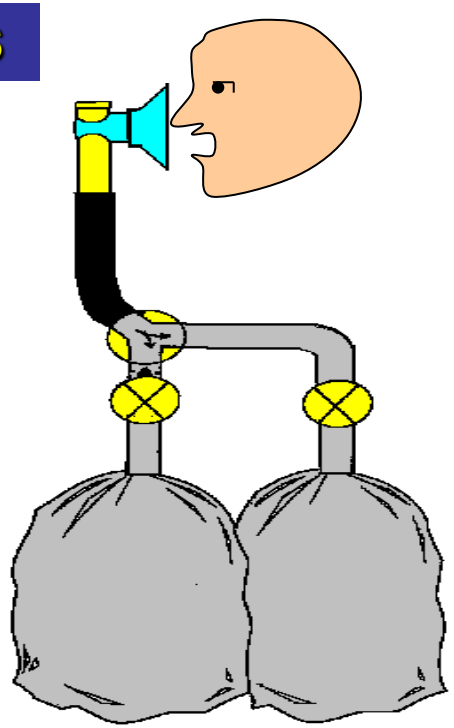
KOH TAKES UP CO2



OPEN CIRCUIT METHOD TO DETERMINE RQ

HALDANE GAS ANALYSIS APPARATUS

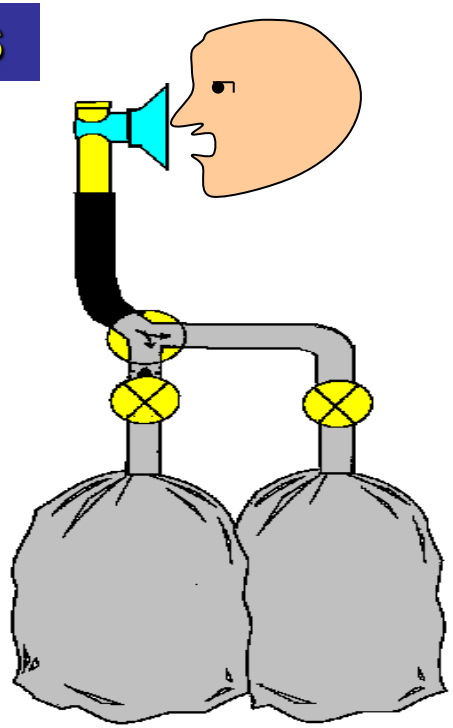
ALKALINE PYROGALLATE



OPEN CIRCUIT METHOD TO DETERMINE RQ

HALDANE GAS ANALYSIS APPARATUS

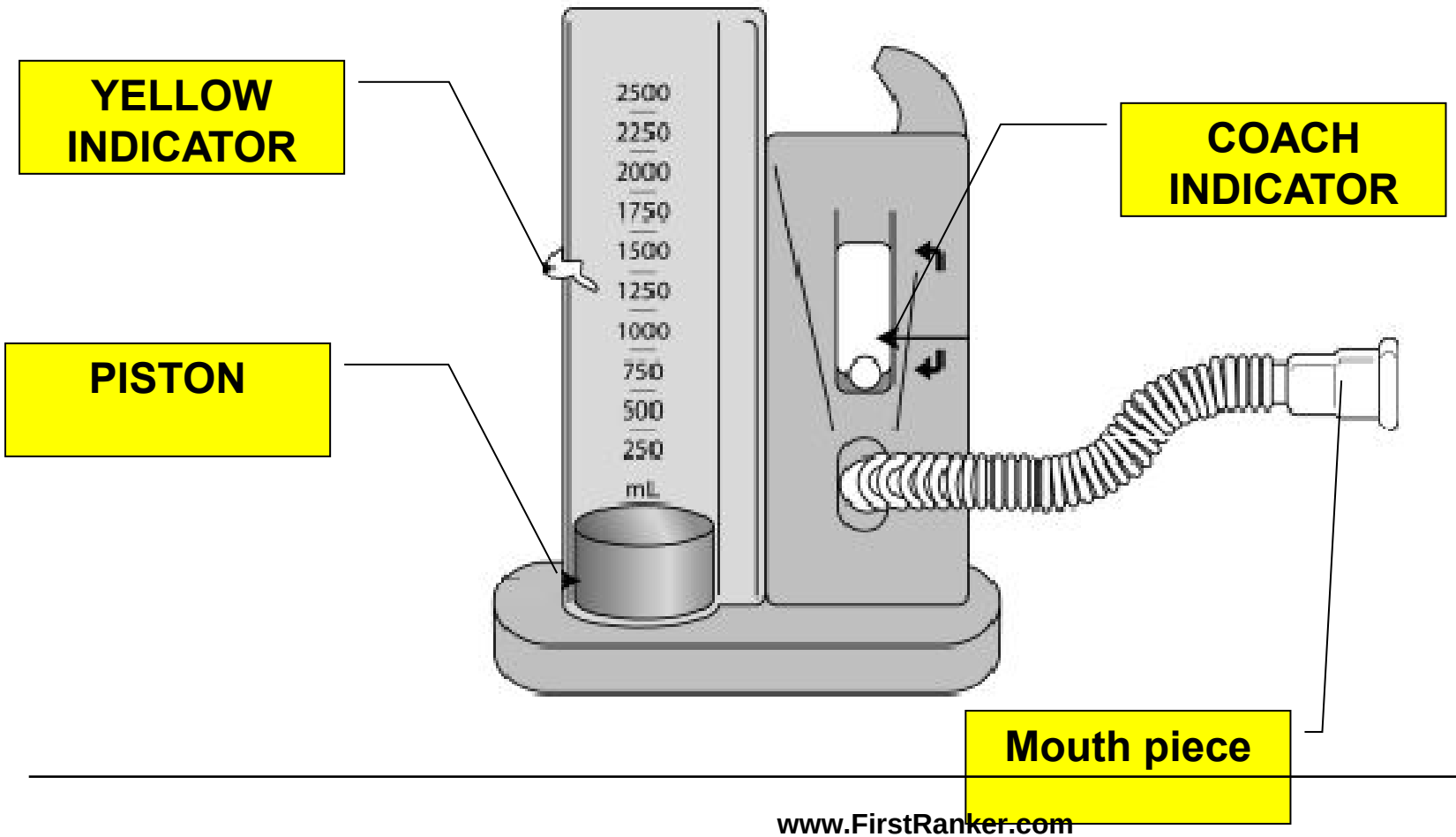
ALKALINE PYROGALLATE TAKES UP O2



$$RQ = \frac{\text{Vol of } CO_2 \text{ exhaled}}{\text{Vol of } O_2 \text{ utilized}}$$

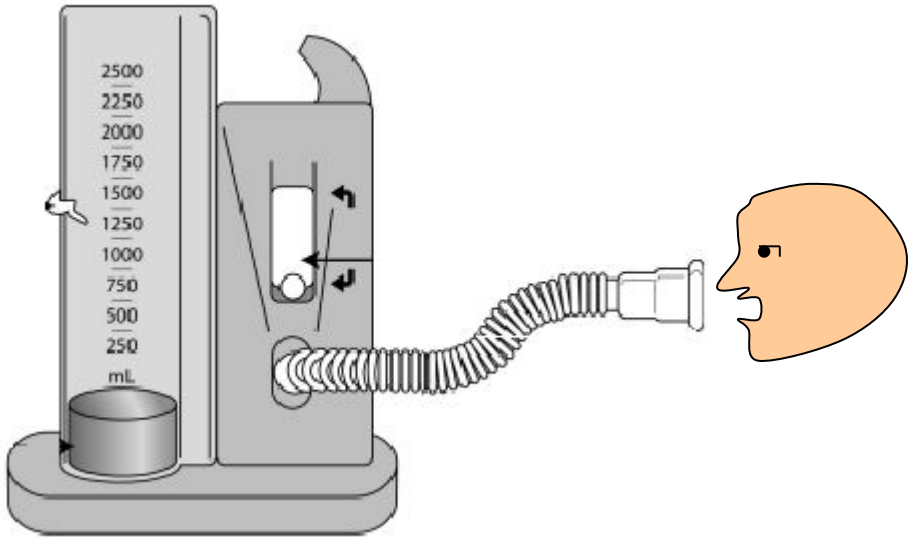
RESPIRATORY QUOTIENT

Spirometer



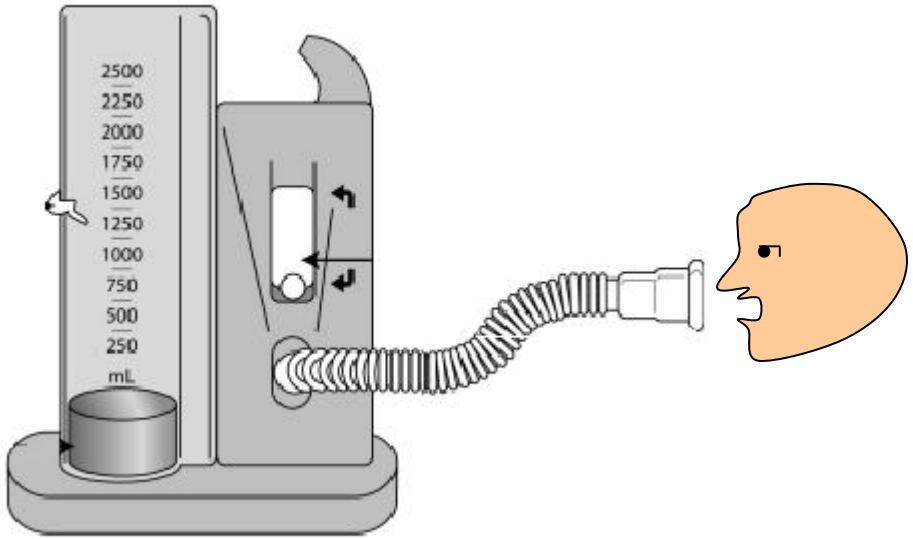
CLOSED CIRCUIT METHOD TO DETERMINE RQ

NaOH

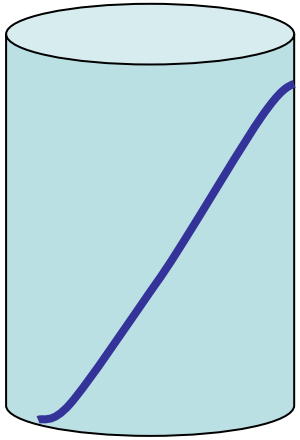


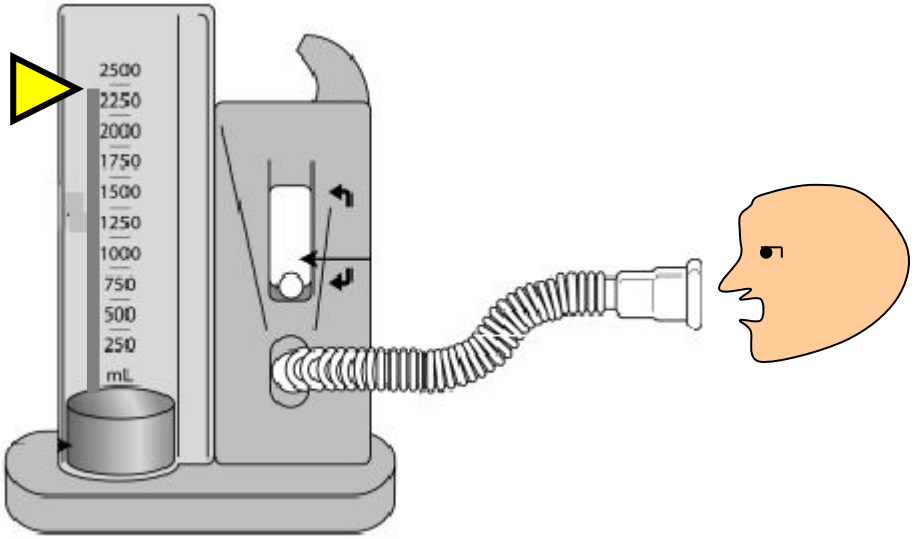
CLOSED CIRCUIT METHOD TO DETERMINE RQ

NaOH takes up CO2



CLOSED CIRCUIT METHOD TO DETERMINE RQ





CLOSED CIRCUIT METHOD TO DETERMINE RQ

- Determination of absorbed CO2

NaOH **CO2**

CLOSED CIRCUIT METHOD TO DETERMINE RQ

- Determination of absorbed CO2

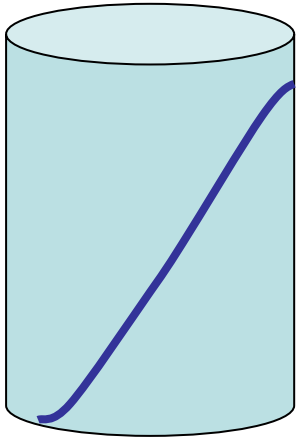
Na2CO3 **H2SO4**

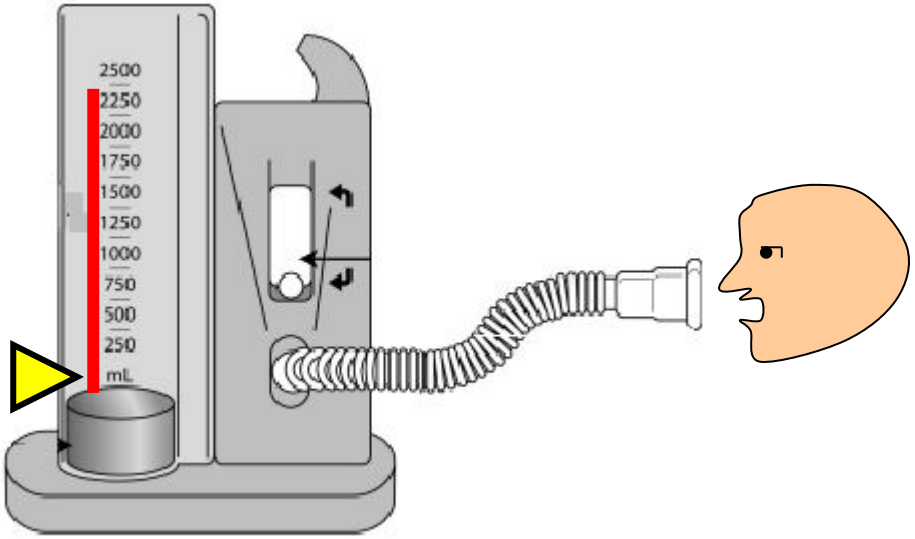
CLOSED CIRCUIT METHOD TO DETERMINE RQ

- Determination of absorbed CO2

Na2SO4	+	H2O	+	CO2

CLOSED CIRCUIT METHOD TO DETERMINE RQ





RQ = Vol of CO2 exhaled / Vol of O2 utilized

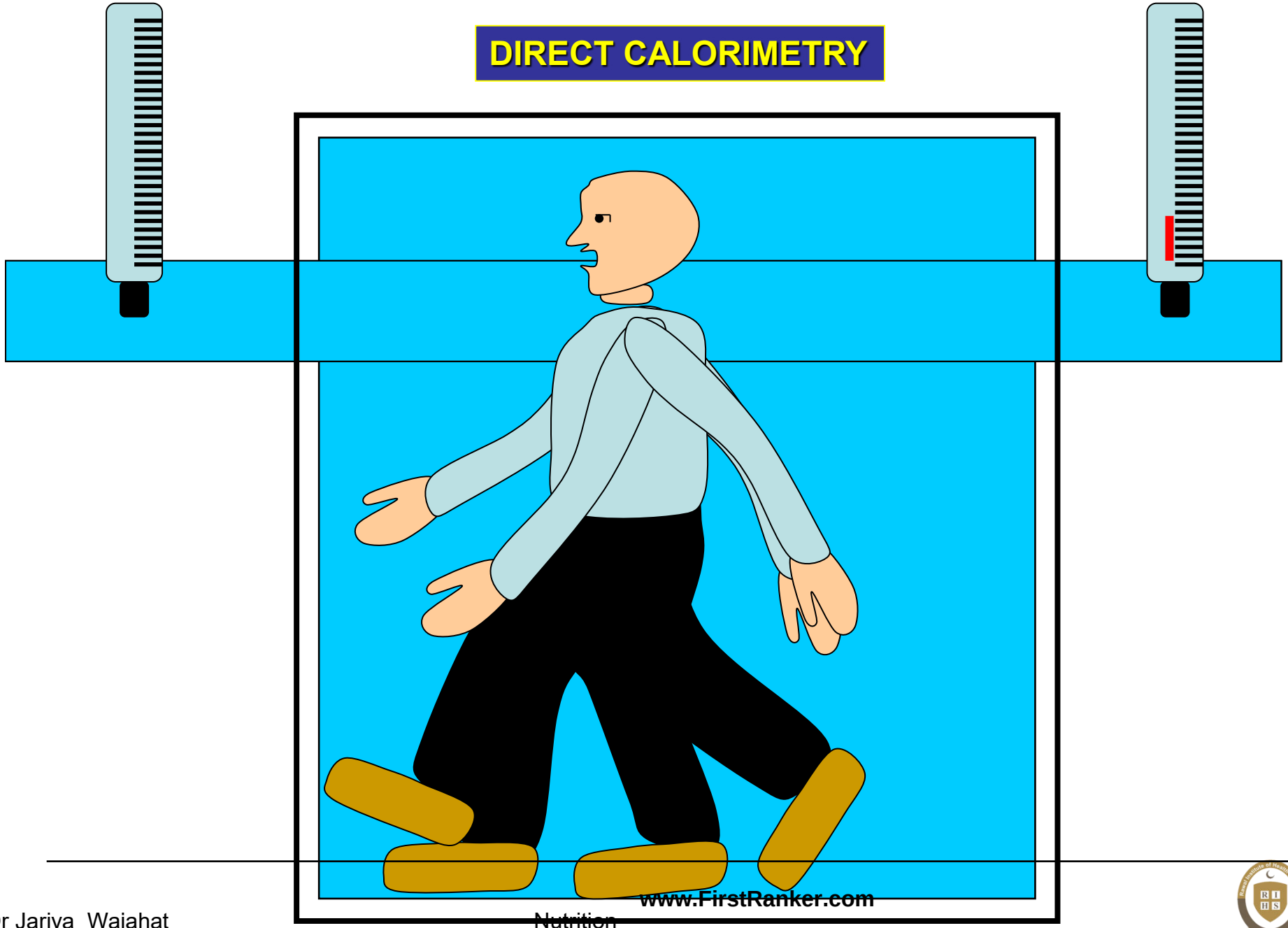
METABOLIC RATE

- "It is the output of energy by a person which is expressed as kcals/ m^2 body surface area/ hr"
- Determination methods
  - Direct calorimetry
  - Indirect calorimetry

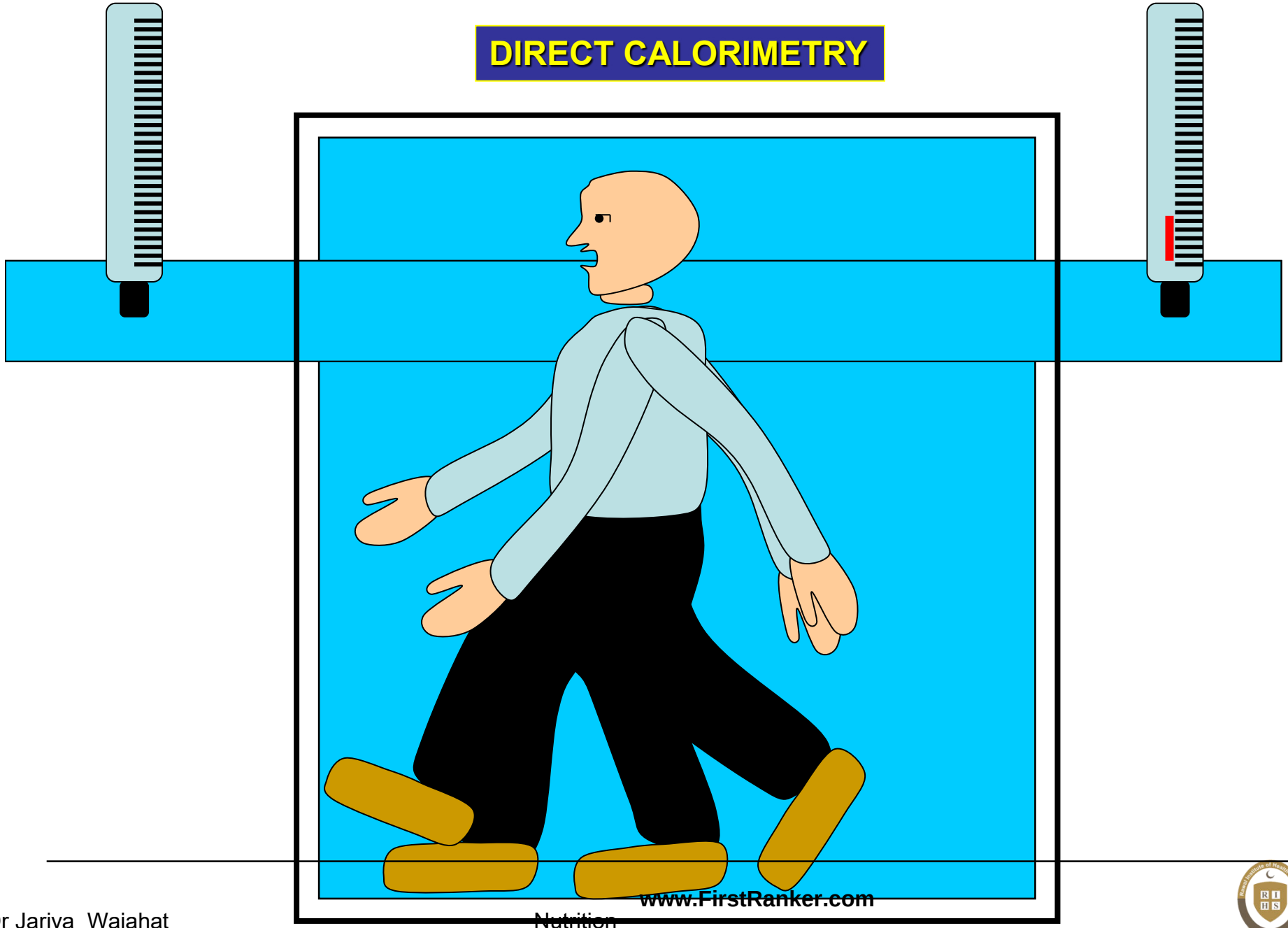
DIRECT CALORIMETRY

- Principle is same as bomb calorimeter except one difference

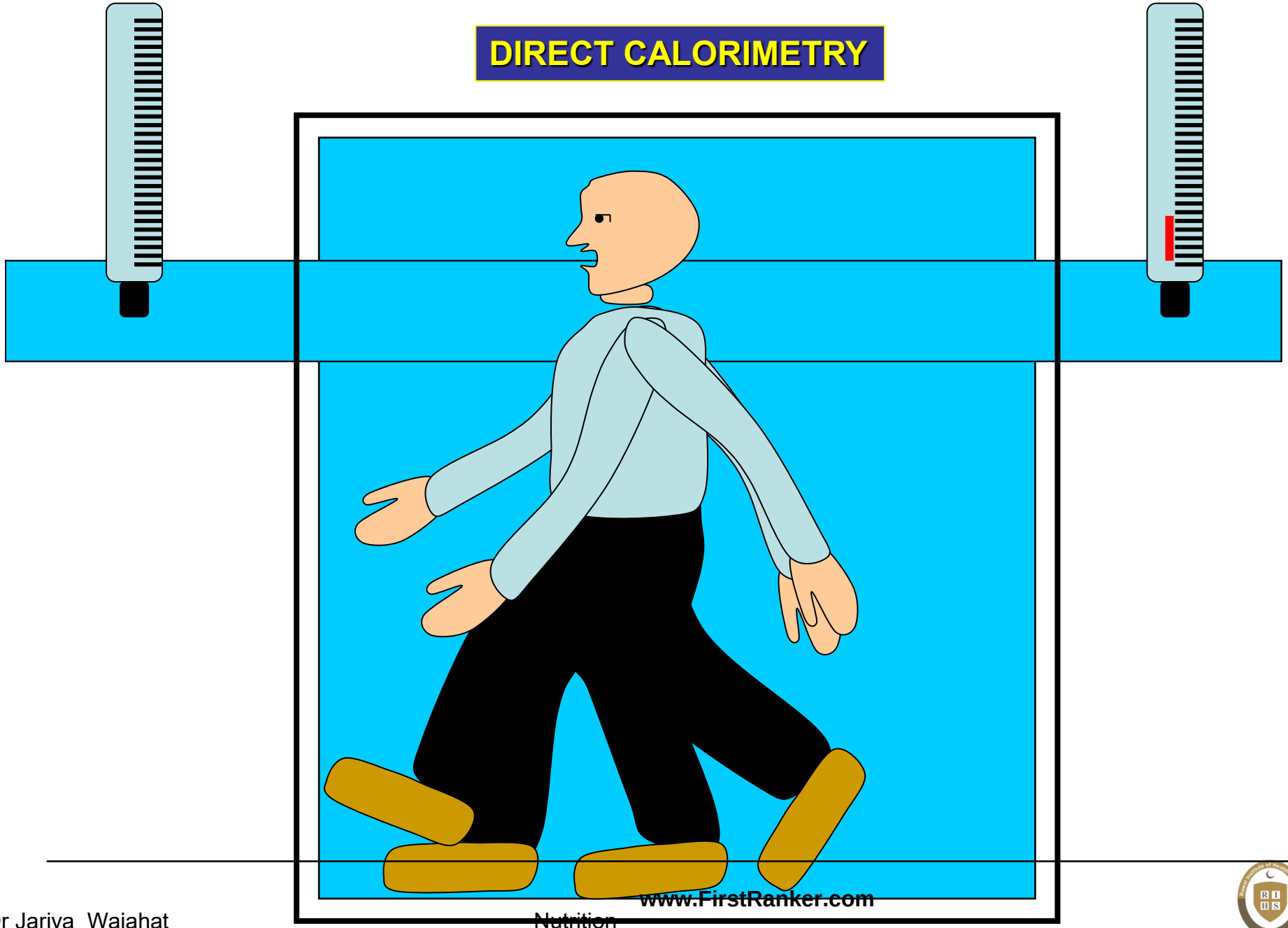
DIRECT CALORIMETRY



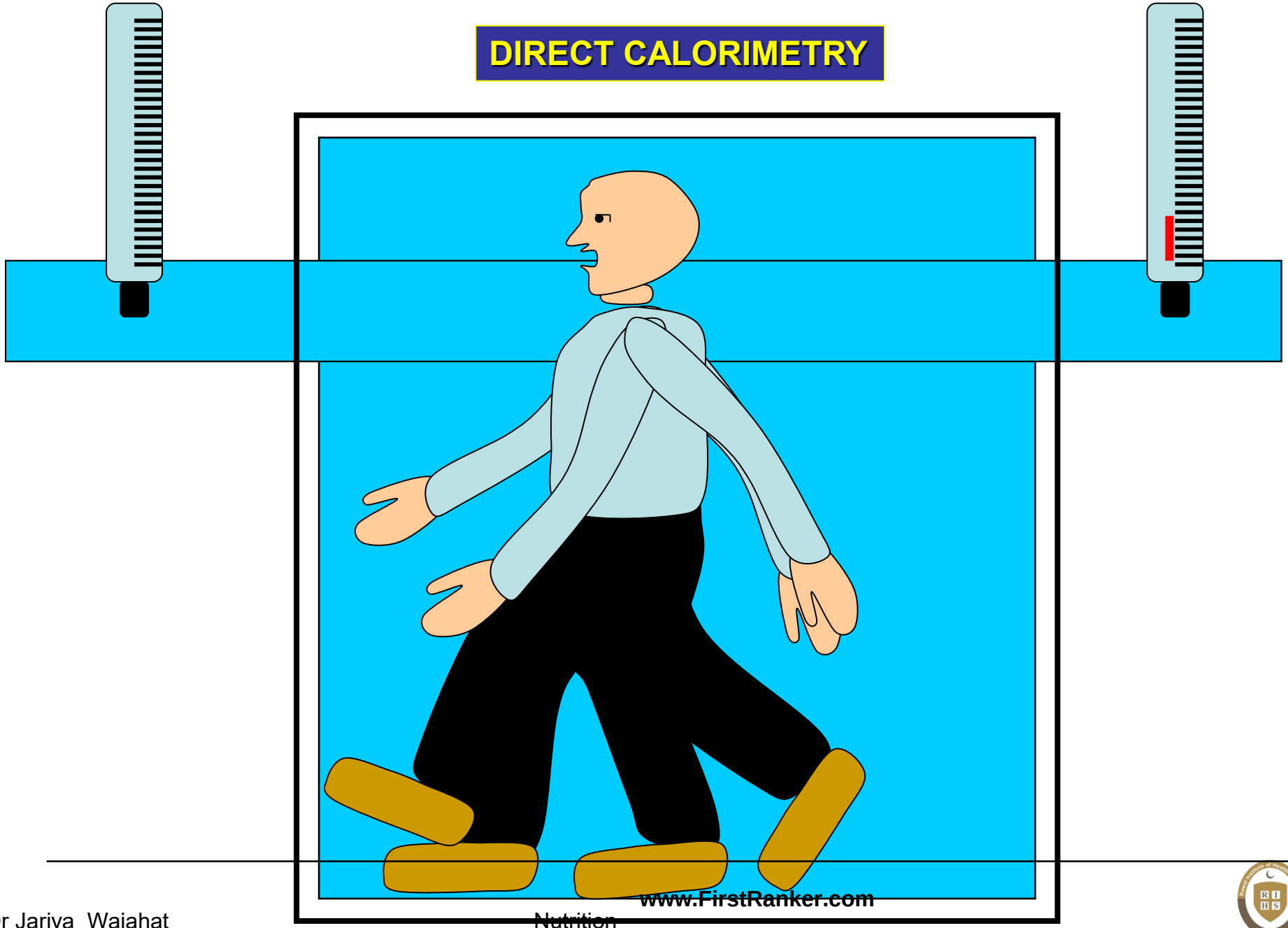
DIRECT CALORIMETRY



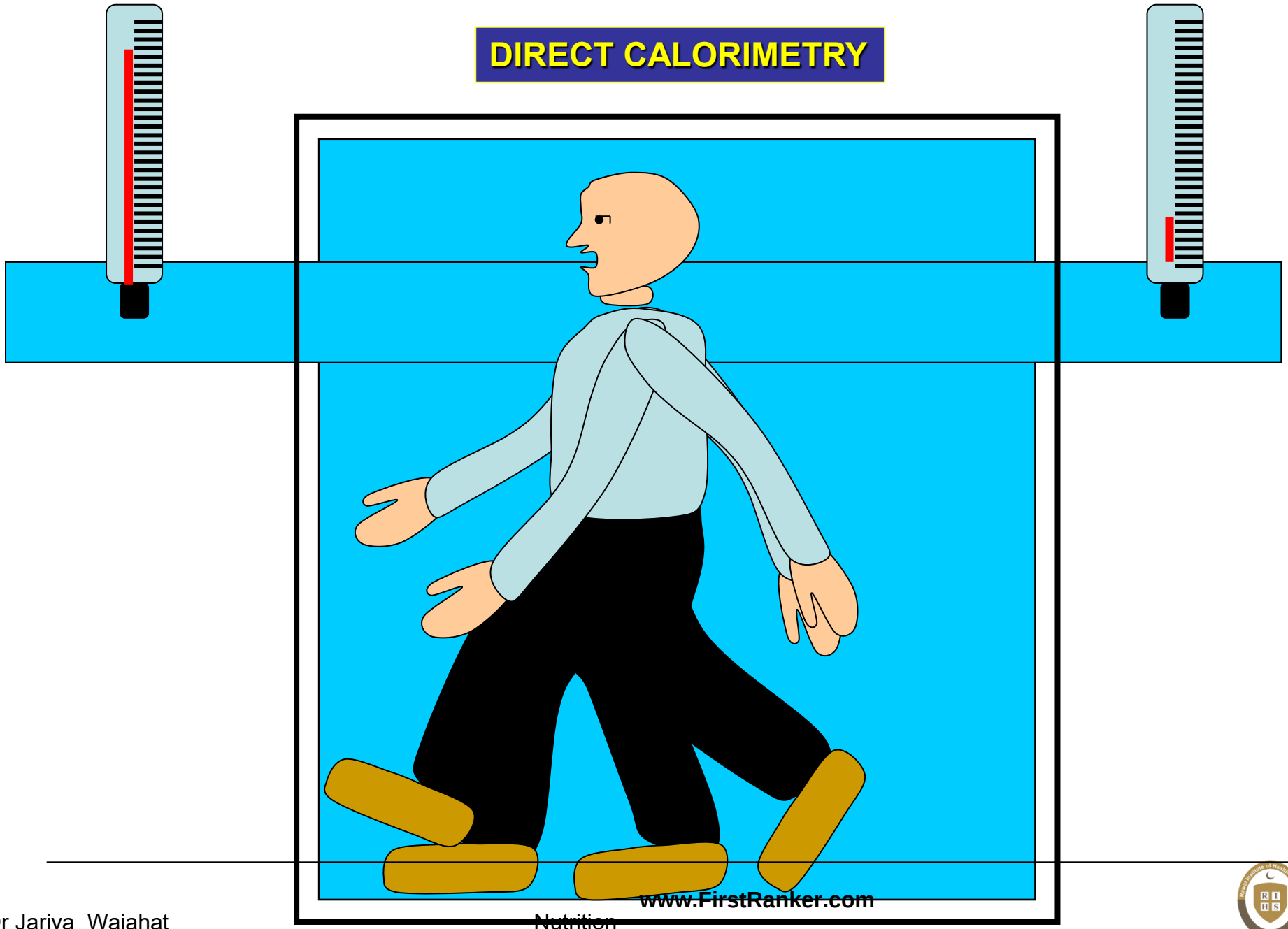
DIRECT CALORIMETRY



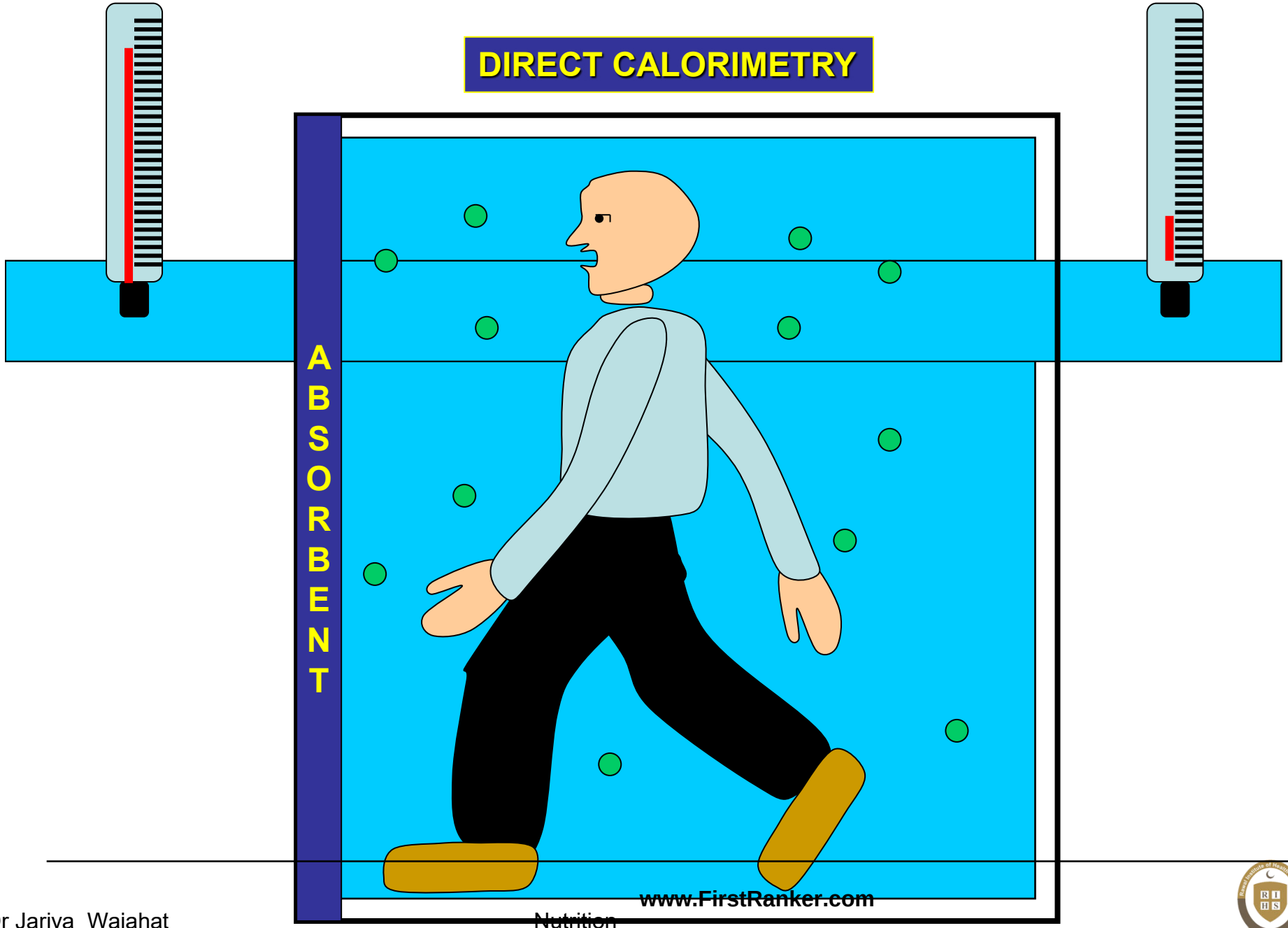
DIRECT CALORIMETRY



DIRECT CALORIMETRY



DIRECT CALORIMETRY



METABOLIC RATE

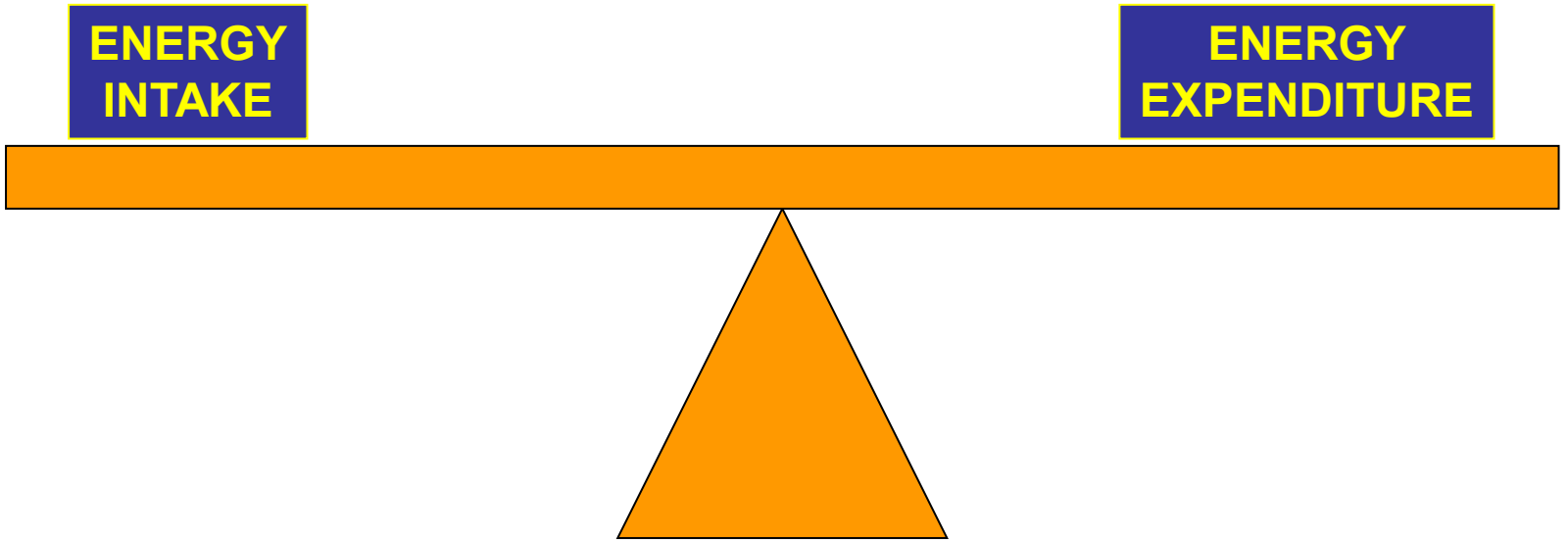
- DIRECT CALORIMETRY
  - Metabolic rate = kcal/m²/hr

INDIRECT CALORIMETRY

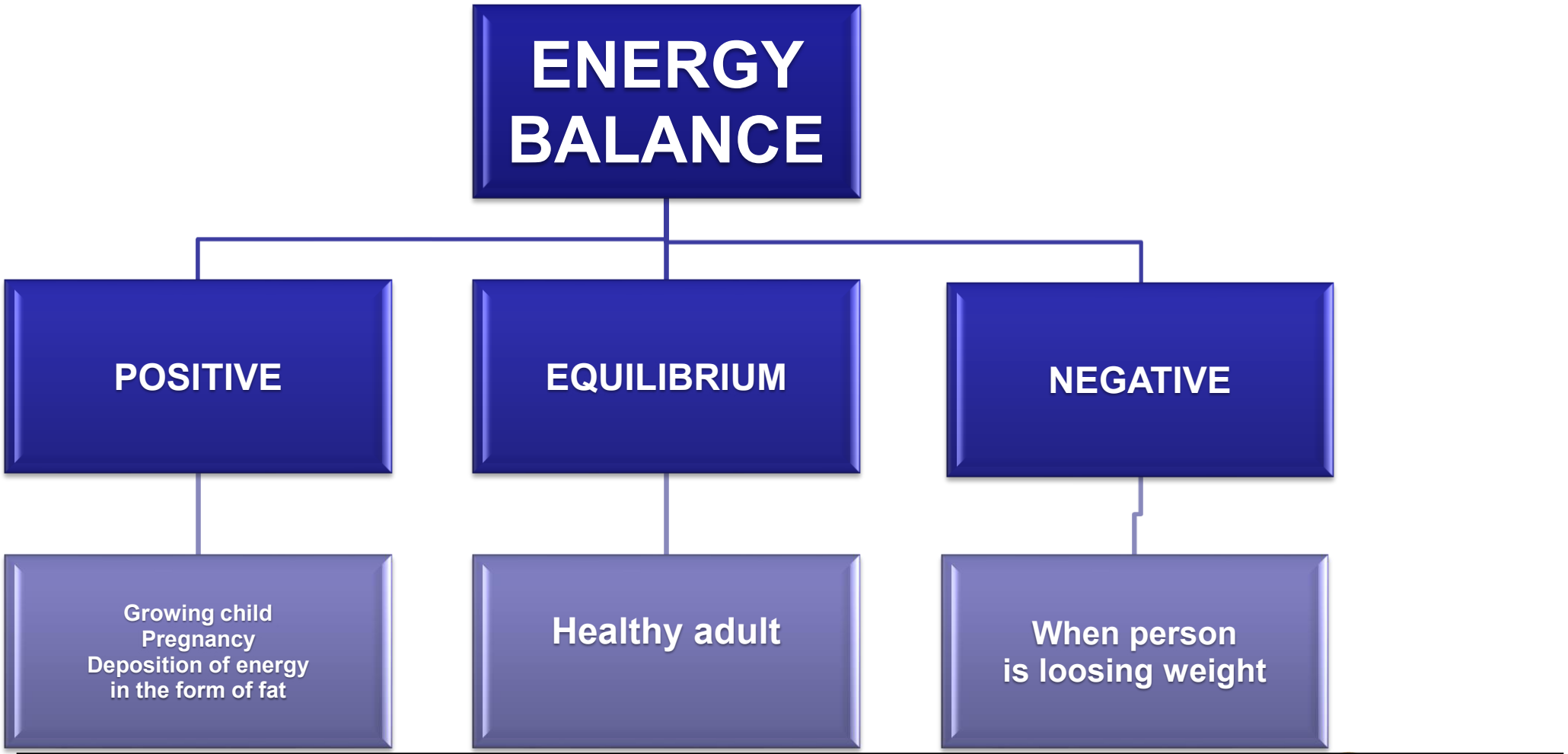
- DETERMINATION OF
  - RQ
  - RATE OF O2 UTILIZATION
- USE OF TABLE
  - Kcal OF ENERGY LIBERATED/ LITER OF O2 CONSUMED AT SPECIFIC RQ FROM TABLE
- CALCULATION OF METABOLIC RATE

RQ	Kcal liberated/ liter of O2 consumed
0.71	4.689
0.75	4.739
0.80	4.801
0.82	4.825
0.85	4.862
0.90	4.924
0.95	4.985
1.00	5.047

ENERGY BALANCE



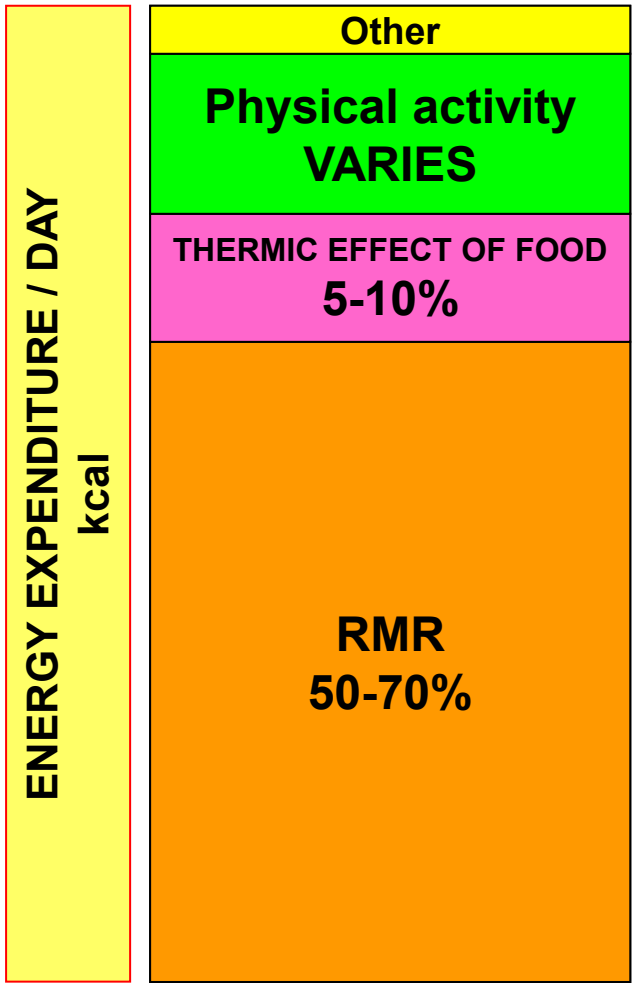
ENERGY BALANCE



ENERGY EXPENDITURE FOR VARIOUS ACTIVITIES

- Basal metabolic rate
  - BMR is the rate of use of body's energy stores. It is determined while at rest after an overnight fast.
- Resting metabolic rate
  - Measured under resting conditions within an hour or a few hours of consuming a meal.
- Sleeping ↓ by **10%**
- Standing from lying position ↑ **30%**
- Thermic effect of food **5-10%**
- Physical activity
- Aging

ENERGY REQUIREMENTS



- Sedentary 30-50% more than RMR
- Highly active 100% or more above RMR

- Respiration
- Blood flow
- Ion transport
- Maintenance of cellular integrity

ENERGY EXPENDITURE FOR VARIOUS ACTIVITIES

Lying at rest 1.0 times BMR

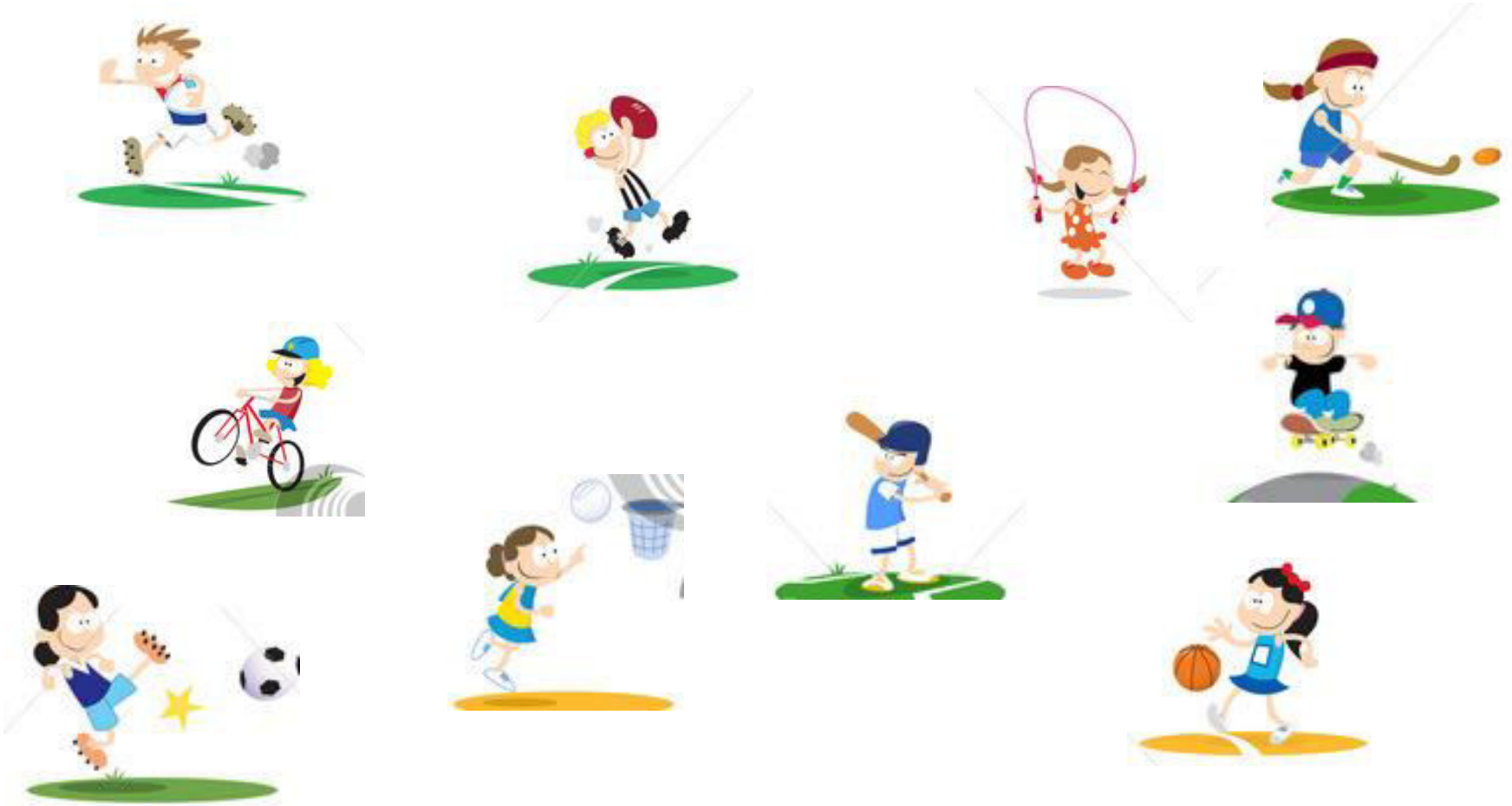
ENERGY EXPENDITURE FOR VARIOUS ACTIVITIES

Very light activity 1.5 times BMR

ENERGY EXPENDITURE FOR VARIOUS ACTIVITIES

Light activity 2.5 times BMR

ENERGY EXPENDITURE FOR VARIOUS ACTIVITIES



Moderate activity 5.0 times BMR

ENERGY EXPENDITURE FOR VARIOUS ACTIVITIES

Heavy activity 7.0 times BMR

Caloric requirements

- Age
- Weight
- Sex
- Physiological factors
- Level of activity

Caloric requirements

- Harris Benedict Equation
  - BMR calculation for men

BMR = 66.5 + (13.75 x wt kg) + (5.003 x ht cm) – (6.755 x age yrs)

  - BMR calculation for women

BMR = 655.1 + (9.563 x wt kg) + (1.850 x ht cm) – (4.676 x age yrs)

Caloric requirements

- Steps
  - Calculate the BMR by Harris Benedict Equation
  - Determine the activity factor
  - Caloric requirement/day
    - Calories/day = BMR X Activity factor

Caloric requirements

- Little to no exercise
  - Daily calories needed = BMR x 1.2
- Light exercise (1–3 days per week)
  - Daily calories needed = BMR x 1.375
- Moderate exercise (3–5 days per week)
  - Daily calories needed = BMR x 1.55
- Heavy exercise (6–7 days per week)
  - Daily calories needed = BMR x 1.725
- Very heavy exercise (twice per day, extra heavy workouts)
  - Daily calories needed = BMR x 1.9

ISSUES IN ENERGY NUTRITION

- Obesity
- Pregnancy and Lactation
- Newborn

Diet in

PREGNANCY AND THE NEWBORN

It is He Who brought you forth from the wombs of your mothers when you knew nothing; and He gave you hearing and sight and intelligence and affections; that you may give thanks.

An Nahl Al Quran

PREGNANCY

- Energy requirement
  - ↑increases by 14% (Should consume 300-500kcal/day in addition to basal requirement)
- Changes in pregnancy
  - Increased BMR
  - Gastrointestinal changes
  - Hormonal changes
  - Changes in the body fluid
  - Altered renal function

PREGNANCY

- Diet in pregnancy
  - Need for calories, proteins, vitamins, minerals and water
- Total weight gain
  - 11 kg
    - Infant 3.3kg
    - maternal fat stores 3.3kg (30,000 kcal of energy)
- Food utilized for
  - Synthesis of new tissues
    - Maternal and fetal
  - Energy for increased biosynthetic activity
  - Deposition of maternal fat

DIET IN PREGNANCY

MILK AND HIGH CALCIUM FOODS

PROTEIN FOODS

BREADS AND GRAINS

DIET IN PREGNANCY

FRUITS AND VEGETABLES

FATS AND OILS

IRON AND THIAMINE RICH FOODS

DIET IN PREGNANCY

FLUIDS

FIBER

VITAMINS AND MINERALS

DIET IN PREGNANCY

ALCOHOL/
SMOKING

OVER GRILLED, CHARRED
OR BLACKENED FOODS

PHOSPHORUS FROM SOFT DRINKS

NEWBORN

- 0-0.5 yr
  - 115 kcal/kg body weight/day
- 0.5-1 yr
  - 105 kcal/kg body weight/day

INFANT

- WEANING
  - Fruit juice
  - Mashed and whipped fruit and vegetables
  - Egg yolk
  - Cereals
- Importance of good nutrition in pregnancy and early infancy
  - Rapid growth
  - Nervous system
  - Immunocompetence

A review of some

NUTRITIONAL DISORDERS

…… the Lord and Cherisher of the worlds, Who created me and it is He Who guides me. Who gives me food and drink. And when I am ill, it is He who cures me. Who will cause me to die, and then to live (again). And Who, I hope, will forgive me my faults on the Day of Judgment.

77-82 Al-Shûarâa Al-Quran

LECTURE CONTENTS

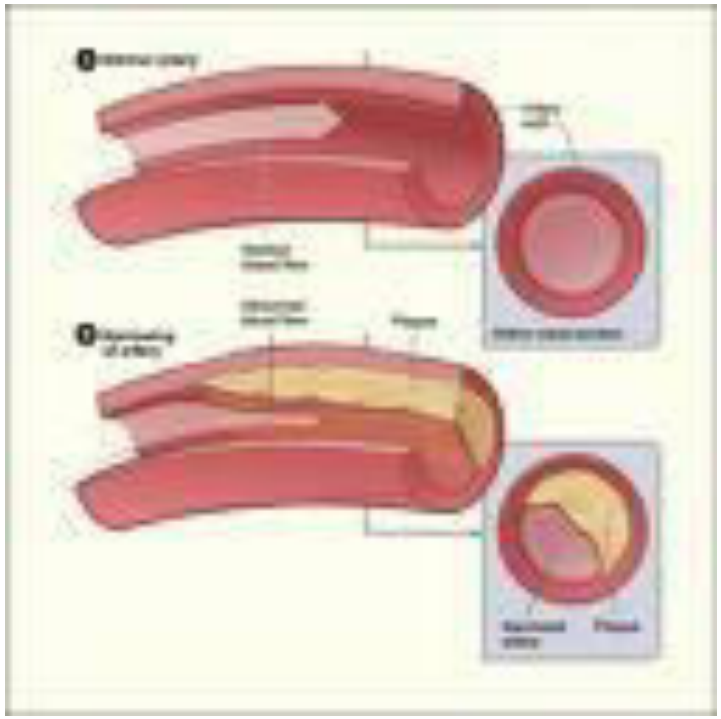
- Deficiency of essential fatty acids
- Coronary artery disease
- Sucrose and dental caries
- Anorexia nervosa
- Bulimia nervosa
- Protein energy malnutrition
- Kwashiorkor

DEFICIENCY OF ESSENTIAL FATTY ACIDS

- Diagnosis
  - Triene/ tetraene ratio in plasma lipids (>0.4)
- Symptoms
  - Scaly dermatitis
  - Hair loss
  - Poor wound healing
- DHA
  - Development of brain and retina
  - Supplied via placenta and milk
  - Deficiency
    - Retinitis pigmentosa

CORONARY ARTERY DISEASE

- Saturated fats
- Cholesterol



SUCROSE AND DENTAL CARIES

- Cola and soft drinks
- Commercial fruit juices
- Candies / chocolates
- White bread

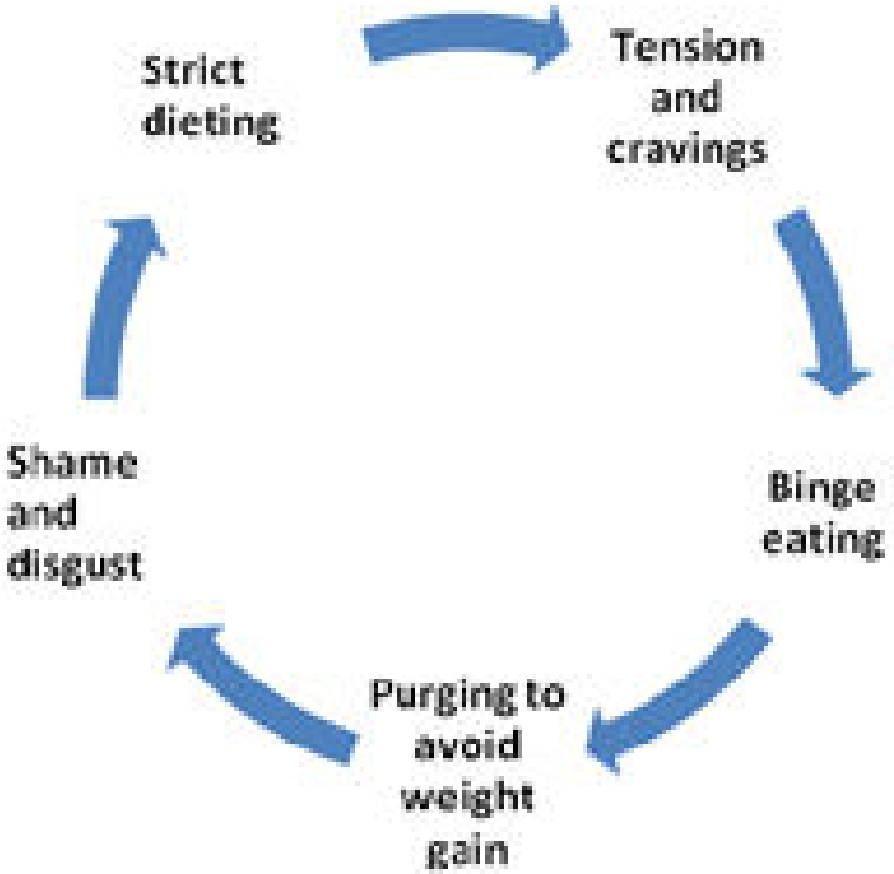
ANOREXIA NERVOSA

- Anorexia nervosa is a psychiatric, eating disorder characterized by low body weight and body image distortion with an obsessive fear of gaining weight.

BULIMIA NERVOSA

- Bulimia nervosa is an eating disorder characterized by recurrent binge eating, followed by compensatory behaviors, referred to as "purging".

BULEMIA NERVOSA



Malnutrition is an imbalance between the nutrients the body needs and the nutrients it gets.

MALNUTRITION

MalNurition

- Undernutrition
- Overnutrition

MALNUTRITION SPECTRUM

PROTEIN ENERGY MALNUTRITION

MARASMUS

KWASHIORKOR

MALNUTRITION SPECTRUM

ENERGY

ENERGY & PROTEIN

PROTEIN

PROTEIN ENERGY MALNUTRITION

MARASMUS

KWASHIORKOR

PEM

- KWASHIORKOR
  - Deficiency of proteins
  - 2-3 yrs age
  - “Disease of the deposed baby when the next one is born.”

- MARASMUS
  - Deficiency of calories
  - Earlier age

MARASMUS

- Marasmus is a severe deficiency of calories and protein. It tends to develop in infants and very young children.
- It typically results in
  - weight loss
  - Dehydration
  - Starvation

POSSIBLE COMPLICATIONS

- Starvation
- Stupor
- Coma
- Death

KWASHIORKOR

- Kwashiorkor is a severe deficiency more of protein than of calories. Kwashiorkor is less common than marasmus.

EDEMA

DECREASED PLASMA PROTEINS (ALBUMIN)

DECREASED PLASMA COLLOID OSMOTIC P

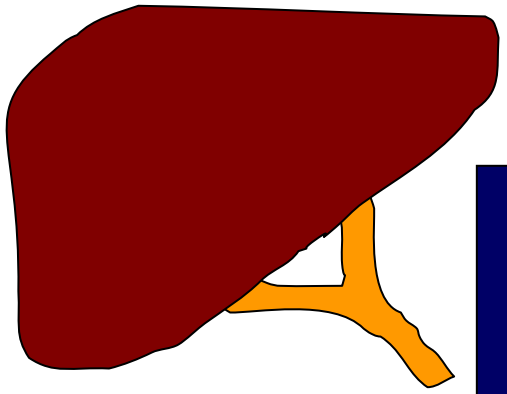
ELECTROLYTE IMBALANCE

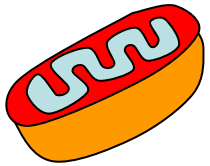
DECREASED ANTIDIURETIC SUBSTANCES

EDEMA

RENAL AND CARDIAC DYSFUNCTION

SERUM AND TISSUE PROTEINS



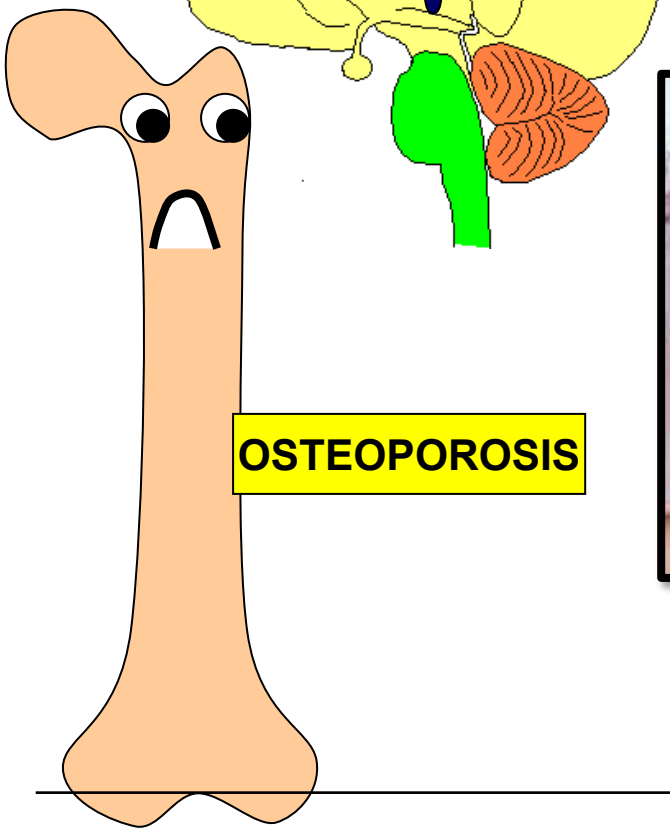


PROTEINS
RNA
RIBOSOMES
CELLULAR AMINO ACID POOL

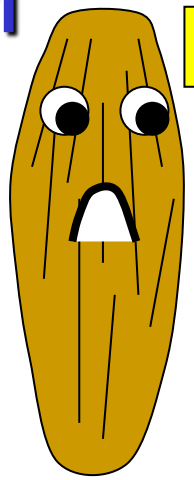
ATROPHY OF PANCREAS, SALIVARY GLAND AND INTESTINE

TROPICAL MALABSORPTION SYNDROME
(IRON, B12)
STEATORRHOEA

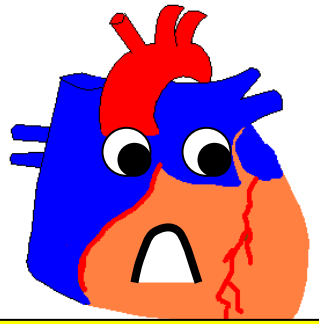
ALTERATIONS IN PROTEIN METABOLISM



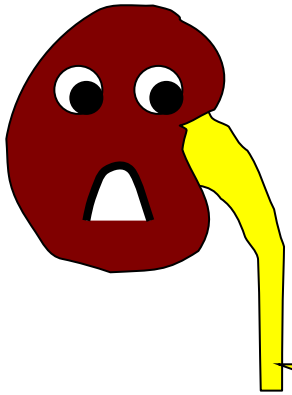
OSTEOPOROSIS



ATROPHY



ALTERED HEMODYNAMICS



CONCENTRATING ABILITY

GFR

DECREASED IMMUNITY

DIMINISHED PHAGOCYTOSIS
ATROPHY OF LYMPHOID TISSUE
↓ T CELL IMMUNITY

POSSIBLE COMPLICATIONS

- Electrolyte imbalances
- Coma
- Permanent mental and physical disability
- Shock

PEM

- KWASHIORKOR
  - Edema
  - Growth retardation to some extent
  - Skin
    - Abnormal hair
    - Dermatosis
  - Mild to moderate anemia
  - Poor appetite
  - Apathy
  - Fatty liver
  - Atrophy of pancreas, salivary gland and intestine
- MARASMUS
  - Cachexia (loss of body fat and gross muscle wasting)
  - Growth retardation
  - Skin
    - Thin and dry
    - Pale and cold
    - Inelastic
  - Appetite is good
  - Internal organs are small but do not exhibit morphological changes