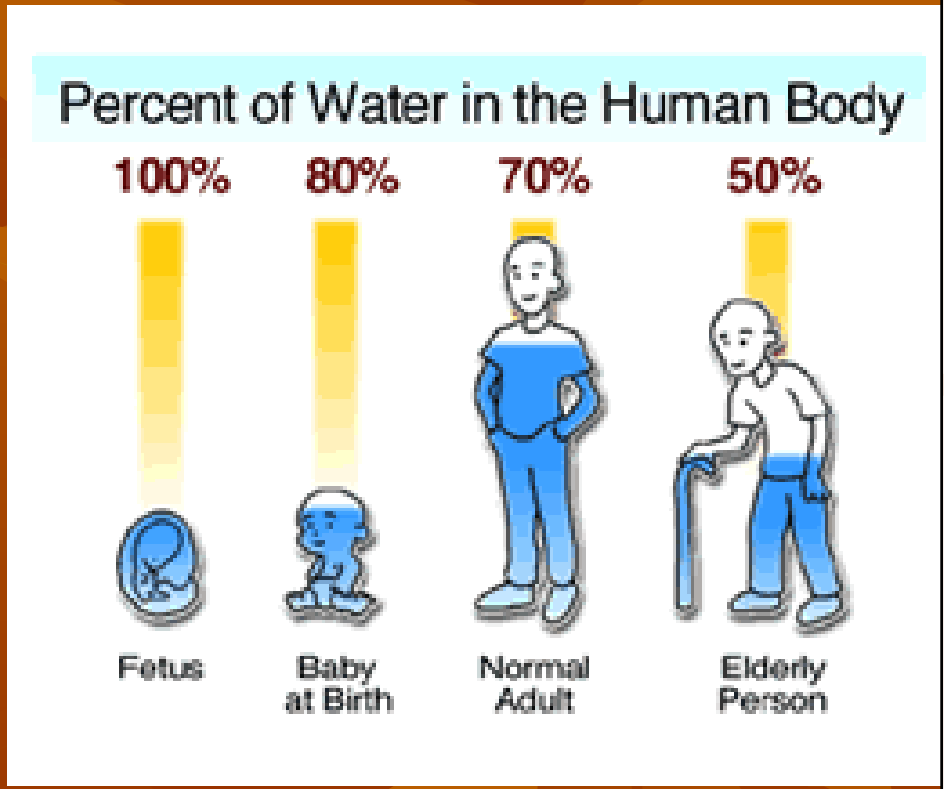
Water, hydratation and exercise

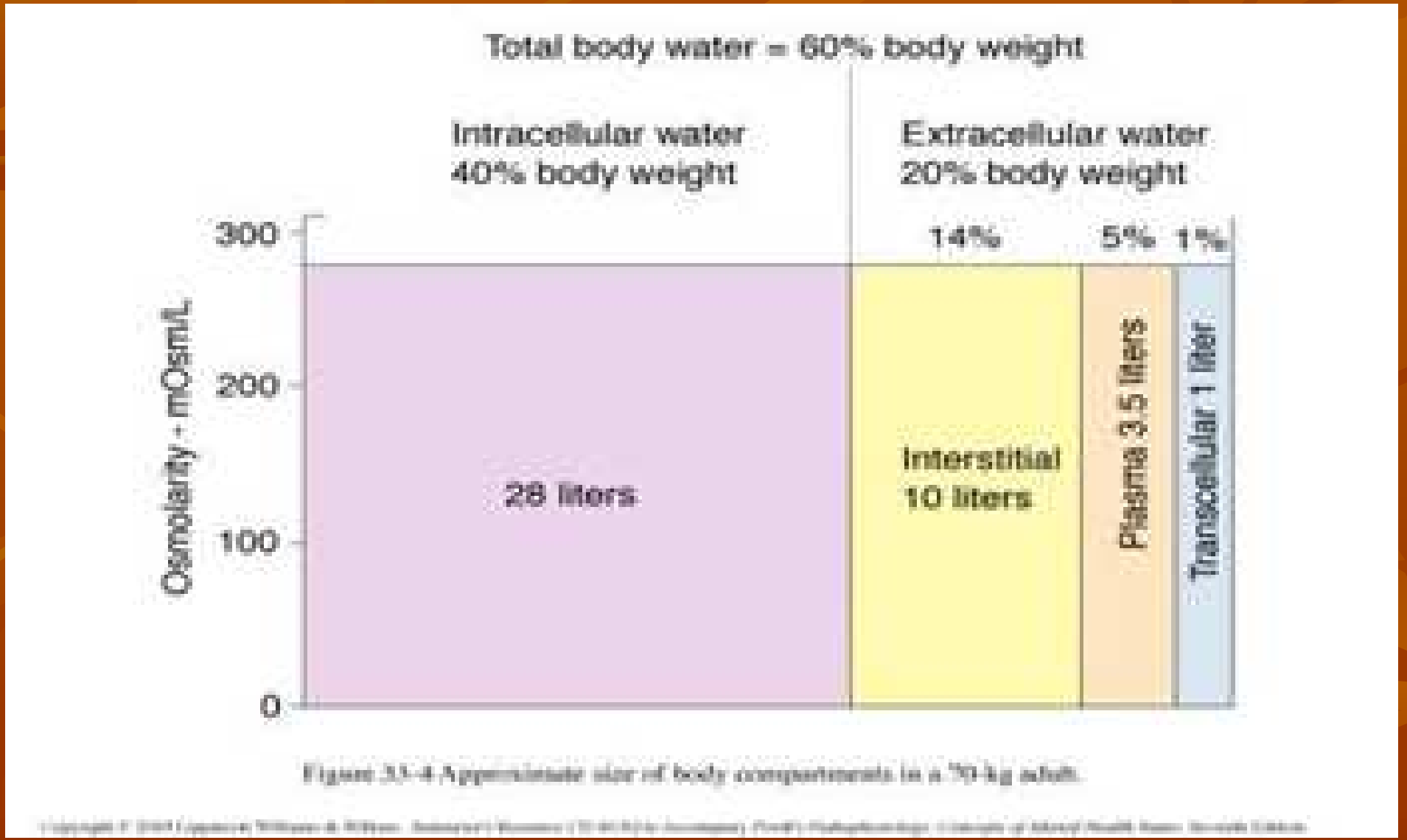
Dehydratation

Water and the body fluids

- The main roles water in body fluids
  - Carries nutrients and waste products throughout the body
  - Maintains the structure of alrge molecules such as proteins and glycogen
  - Participates in metabolic reactions
  - Serves as the solvent for minerals, vitamins, aminiacids, glucose, and many other small molecules
  - Acts as a lubricant nad cushion around joints and inside the eyes, the spinal cord, and, in pregnancy, the amniotic sac surrounding the fetus in the womb
  - Aids in the regulation of body temperature
  - Maintains blood volume

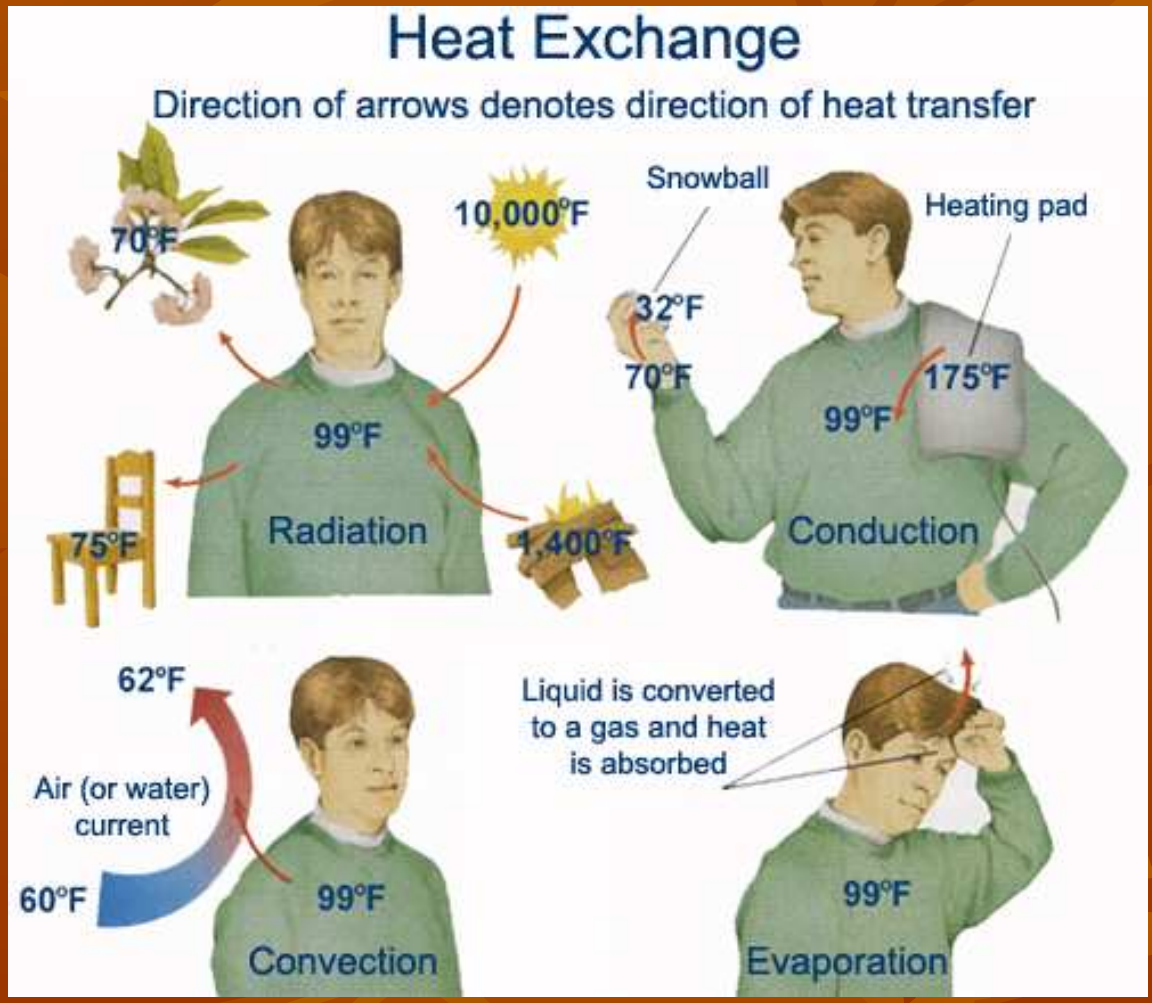


Distribution of body water



Roles of body water

- The medium of the body
- Homeostasis
- Regulation of body temperature
  - Sweating (convection, conduction, radiation, evaporation (sweat))
- Serve as a key factor in urine formation
- Control blood pressure – ADH, aldosterone



Water balance

Water sources	Amount (ml)	Water losses	Amount (ml)
Liquids	550 – 1500	Kidneys	500 – 1400
Foods	700 – 1000	Skin	450 – 900
Metabolic water	200 – 300	Lungs	350
		Feces	150
	1450 – 2800		1450 - 2800

Water recommendations

- General recommendations for adults
  - 2 – 3 liter of water (7 – 11 cups)
    - Good sources of water
      - Water, fruit juice, fruit and green tea
    - Bad source of water
      - Coffee, black tea, alcoholic beverages, nonalcoholic beverages rich in caffeine
- Adults 1,0 – 1,5 ml/kcal expended
- Infants 1,5 ml/kcal expended

Dehydratation

Effect of body water loss on physiological performance	
% body weight loss as water	Physiological effect
1 – 2 %	Thirst, some fatigue and minor reduction in strength
3 – 4 %	Reduction in maximal aerobic power and endurance, increase rate of overheating due to plasma volume reductions, compromised thermoregulation
5 – 6 %	Decreased concentration and focus, headache, increased breathing, reduction in regulation of thermoneutrality, decreased cardiac output, chills, nausea, rapid pulse
7 – 10 %	Dizzines, muscle spasms, poor balance, delirium, exhaustion, collapse, progressive reductions in plasma volume, potential cardiogenic shock

Exercise and body water distribution

- Increased sweating and breathing => water loss

- Reduction of blood volume = a flux of water from plasma into ISF and ICF in active sceletal muscle
  - Durin ginitial phase of endurance exercise
  - During strength and power exercise

Physiological effects of reduced plasma volume

Sweating without water replacement

=>

Reductions in plasma volume

=>

Increased plasma osmolality

=>

Decreased plasma volume

=>

Reduced cardiac output

=>

Decreased blood flow to skin

=>

Decreased sweat production

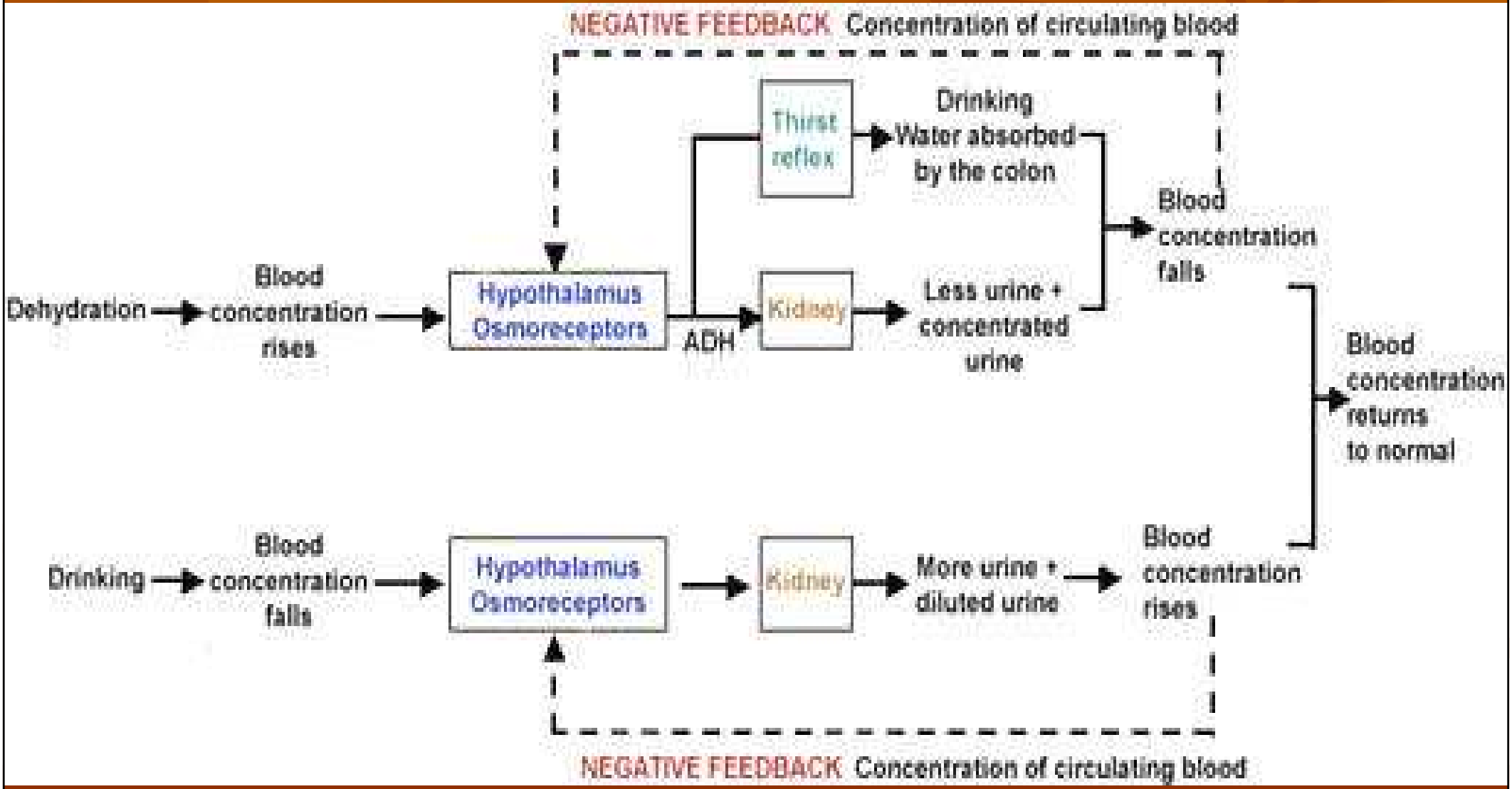
=>

Increased body core temperature

=>

Fatigue

Maintain the blood volume and blood pressure



Exercise-induced sweating

- The breakdown of energy nutrients => generation of excessive heat => sweating (the primary mechanism for releasing heat)
- Sweat rate 1 – 2 l/hour (2 – 3 l/hour)
- Higher temperature = ↑ sweating
- Sweating of children
  - Greater ratio of surface than adults
  - Better nonsweating mechanisms
  - Lower sweat rate than adults
- Adaptation
  - greater production of volume
  - Less concentrated sweat solution (↓ sodium, chloride)
- Swimming
  - Heat loss by convection
  - Lower degree adaptation to sweat loss

Estimating sweat loss

$$(A - B) + (C + D)$$

- A = weight before exercise
- B = weight after exercise
- C = water consumed during exercise
- D = water urinated during and after exercise

Sweat rate (L/hr or ml/min) =
total estimated sweat loss / elapsed time of exercise

- **Example**
  - A = 84,1 kg, B = 82,7 kg, C = 1 kg (1 l), D = 0,1 kg (100 ml)
  - (84,1 – 82,7) + (1 + 0,1) = 2,5 kg (2500 ml)
  - 2,5 L/ 2 hr = 1,25 L/hr = 0,3 L/15 min.
  - Recommendation: drink 300 ml every 15 minutes

Practical guidelines for water consumption

- **Water consumption before exercise**
  - A day before competition, training
    and
  - **2 – 3 hr before training, competition 400 – 600 ml**
  - **Experiment with fluid volume and composition**
  - Source of fluid: water, 4 – 8 % carbohydrate drink, electrolyte drink
    - Carbohydrate – tops up muscle glycogen fuel
    - Sodium reduces urine losses before exercise
  - Athletes who train shortly after waking in the morning – drink in the evening and also before training – 500 – 1000 ml 1 hour before

Practical guidelines for water consumption

- **Water consumption during exercise**
  - For longer and more efective training and competition
  - 150 – 350 ml every 15 – 20 minutes
    = 600 – 1200 ml/hr
  - **Drrink before you feel thirsty !!!**
  - Composition of sport drink
    - 6 – 8 % carbohydrate (55 – 80 g carbohydrate/hr.)
    - Glucose, sucrose, maltodextrines, fructose
    - Sodium 0,5 – 0,7 g/l – stuimulate absorption of carbohydrate and water

Practical guidelines for water consumption

- **Water consumption after exercise**
  - During trainnig 1 – 2 % reduction of weight
  - It take several hours to restore body water in all fluid compartments
  - 500 – 100 ml during first 30 minutes
  - 1 L every 1 – 2 hours until 150 % of sweat weight loss
  - Composition
    - Energy - glucose, sucrose, maltodextrines, fructose
    - Electrolytes – sodium, potassium

Fluids

- **Sports water**
  - Lightly flavoured with a lower carbohydrate (0 – 4 %) and electrolyte (0 – 12 mg/100 ml) content
  - For moderate exercise of less than an hour
- **Sport drinks**
  - Higher amount of carbohydrate (4 – 8 %) and electrolyte (20 – 60 mg/100 ml)
  - For intensive exercise
  - For exercise longer than an hour
- **Water**
  - For low intensity or short duration (less than 45 min.)
- **Soft drinks, fruit juice**
  - Too high in carbohydrate (8 – 14 %)
  - Too low in electrolytes (7 – 10 mg/100 ml)
  - Carbonation – **decreses voluntary fluid intake**
- **Energy drinks**
  - Too high carbohydrate (10 – 13 %)
  - Added ingredients (vitamine, taurine, caffeine