

# Water, hydration and exercise

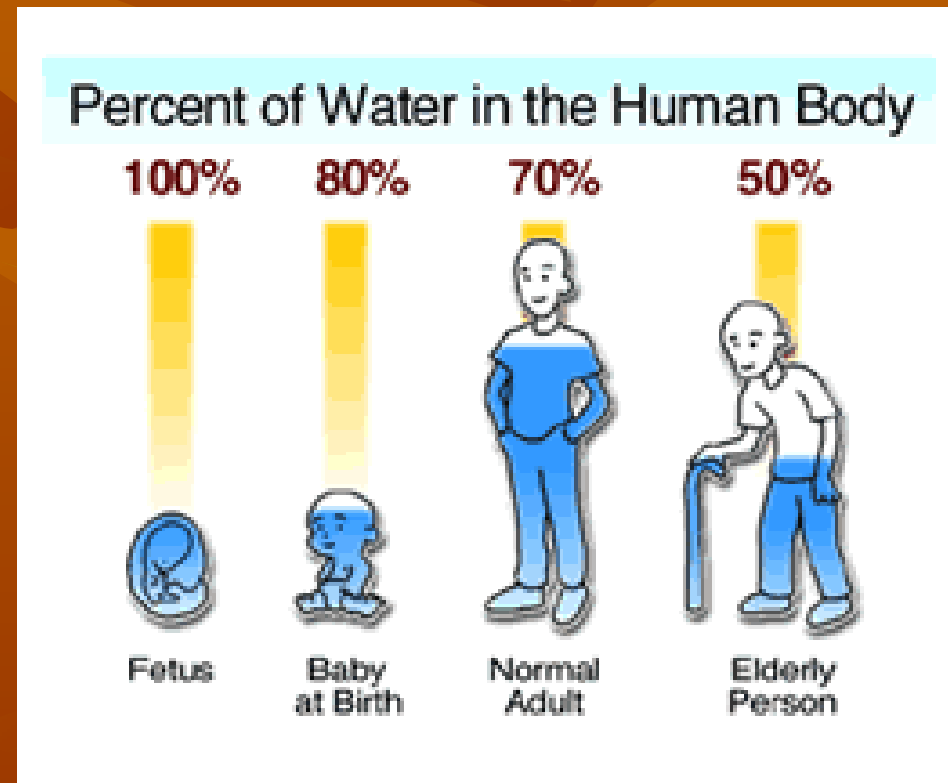
## Dehydration



# Water and the body fluids

## ■ The main roles water in body fluids

- Carries nutrients and waste products throughout the body
- Maintains the structure of large molecules such as proteins and glycogen
- Participates in metabolic reactions
- Serves as the solvent for minerals, vitamins, amino acids, glucose, and many other small molecules
- Acts as a lubricant and 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

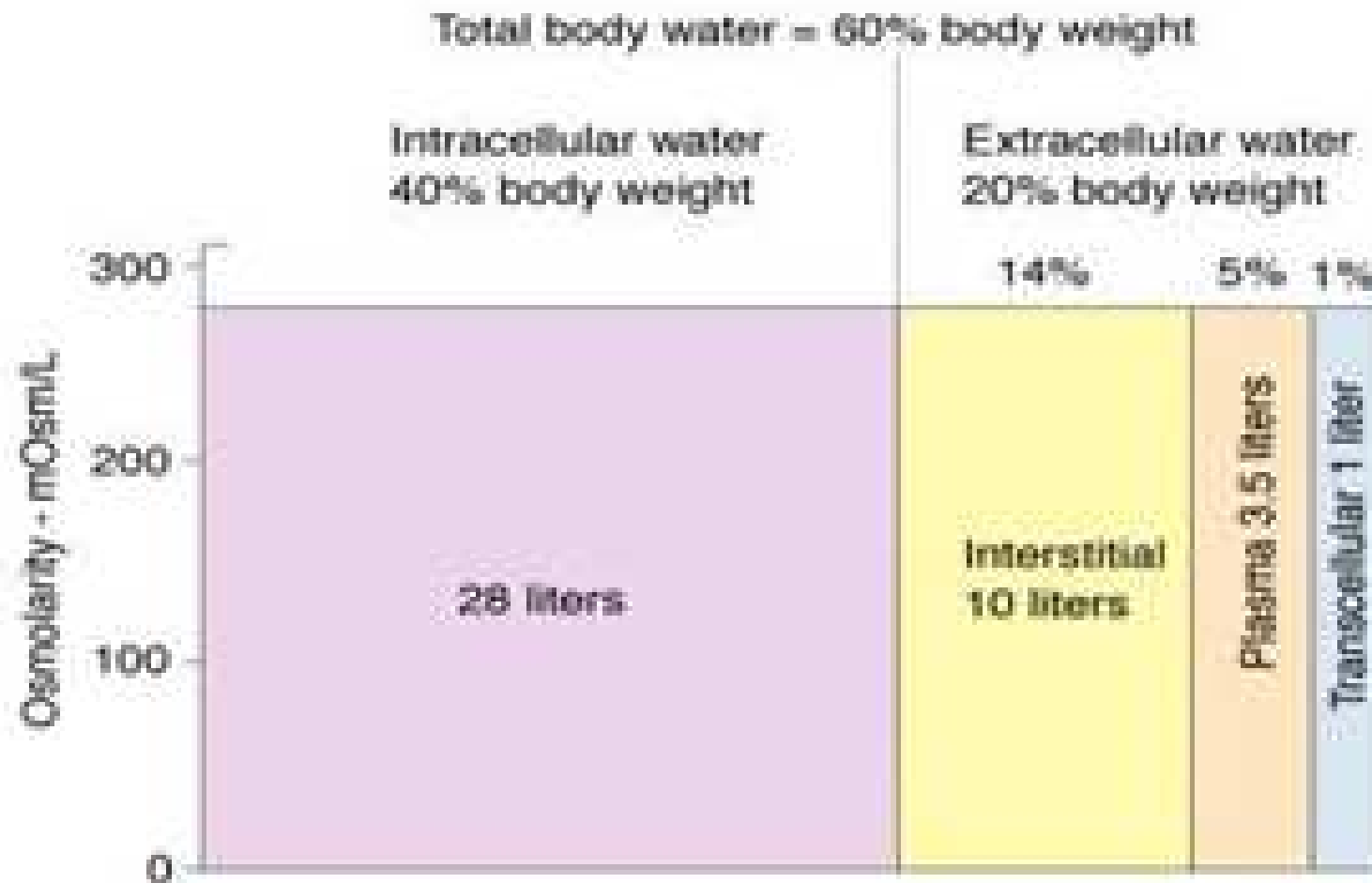
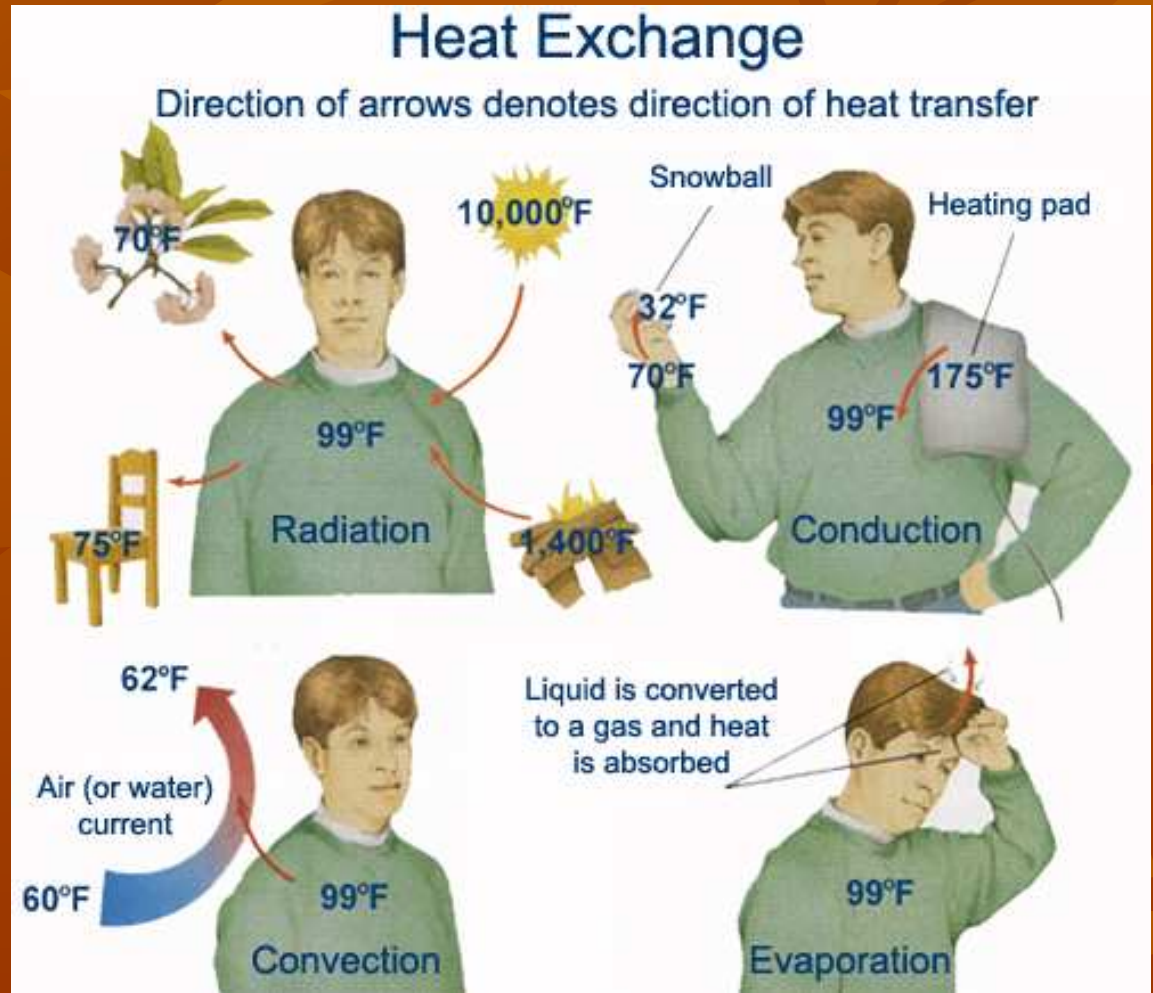


Figure 33-4 Approximate size of body compartments in a 70-kg adult.

# 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

# Dehydration

## 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 %	Dizziness, 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 skeletal muscle
  - During initial phase of endurance exercise
  - During strength and power exercise



# Physiological effects of reduced plasma volume

Sweating without water replacement

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Reductions in plasma volume

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Increased plasma osmolality

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Decreased plasma volume

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Reduced cardiac output

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Decreased blood flow to skin

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Decreased sweat production

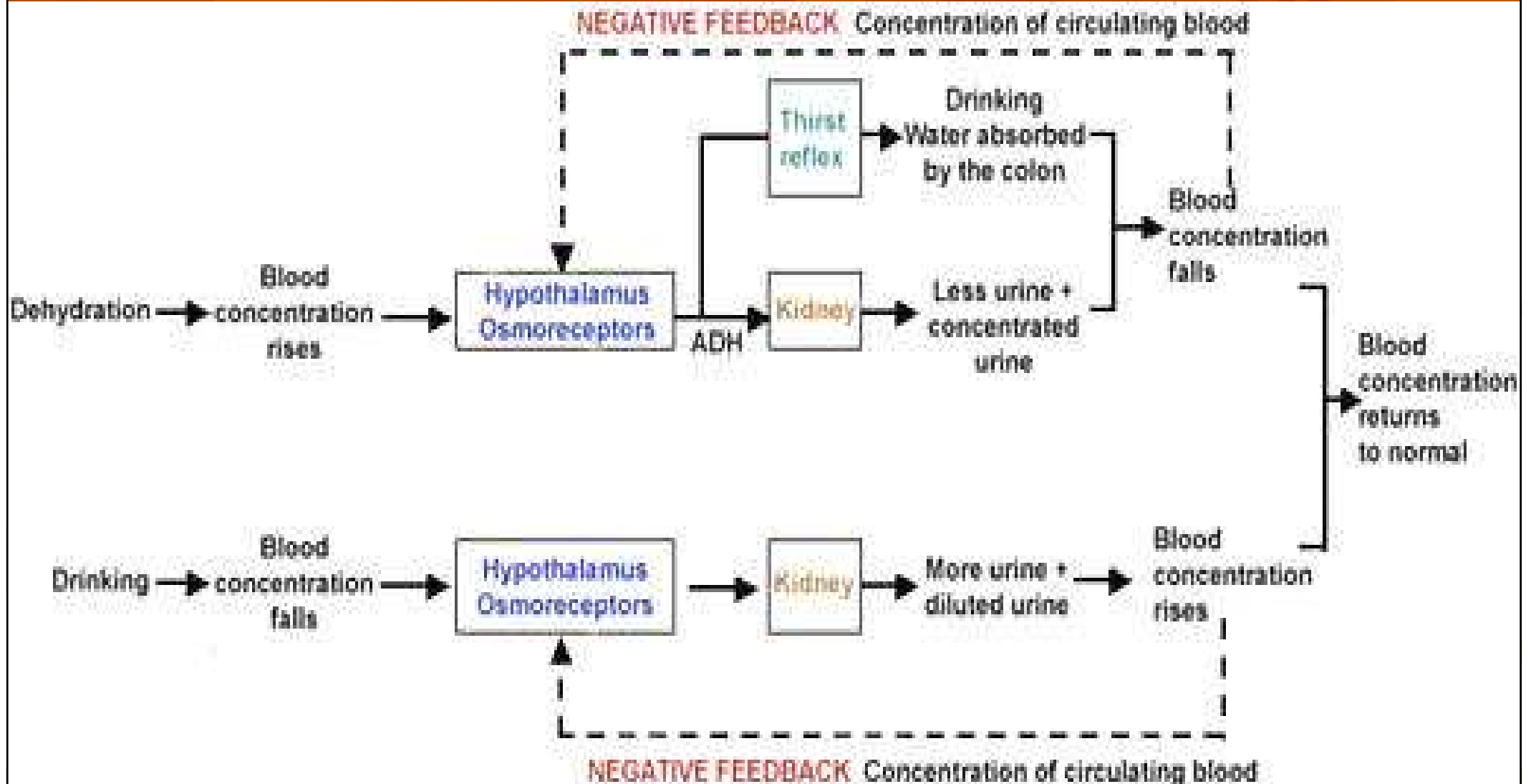
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Increased body core temperature

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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)
- $(84,1 - 82,7) + (1 + 0,1) = 2,5 \text{ kg (2500 ml)}$
- $2,5 \text{ L} / 2 \text{ hr} = 1,25 \text{ L/hr} = 0,3 \text{ L/15 min.}$
- 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 effective training and competition
  - 150 - 350 ml every 15 - 20 minutes  
= 600 - 1200 ml/hr
  - **Drink 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 - stimulate absorption of carbohydrate and water

# Practical guidelines for water consumption

- **Water consumption after exercise**
  - During training 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 - **decreases voluntary fluid intake**
- **Energy drinks**
  - Too high carbohydrate (10 - 13 %)
  - Added ingredients (vitamine, taurine, caffeine)