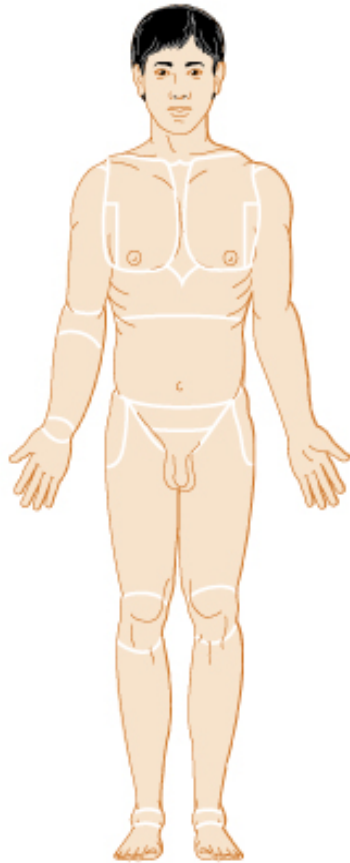


Fluids & Ions



(a) Anterior

function: provide constant internal environment for metabolic reactions

3 balances:

- 1) water balance**
- 2) ion balance**
- 3) acid base balance***

***buffer system**

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% Body Fluid & Weight

	% body fluid	% body wt	liters
Total	100	60	40
ICF	62	40	25
ECF	38	20	15
a) IF	26	16	12
b) plasma	7	4	3

Ion Concentrations

ECF:

a) plasma

major: $\text{Na}^+ > \text{Cl}^-$

minor: $\text{HCO}_3^- > \text{protein} > \text{K}^+$

trace: $\text{Ca}^{2+}, \text{Mg}^{2+}, \text{HPO}_4^{2-}, \text{SO}_4^{2-}$

b) IF:

major: $\text{Na}^+ > \text{Cl}^-$

minor: $\text{HCO}_3^- > \text{org. acids} > \text{K}^+$

trace: $\text{HPO}_4^{2-}, \text{Ca}^{2+}, \text{Mg}^{2+}, \text{SO}_4^{2-}, \text{protein}$

ICF: major: $\text{K}^+ > \text{HPO}_4^{2-} > \text{protein}$

minor: $\text{Mg}^{2+} > \text{SO}_4^{2-} > \text{HCO}_3^- > \text{Na}^+$

trace: $\text{Ca}^{2+}, \text{Cl}^-, \text{org. acids}$

Ion Notes

- 1) **major ion: ICF = K^+ , phosphate⁻, HCO_3^-
ECF = Na^+ , Cl^- , HCO_3^-**
- 2) **trace minerals also important:**
 - **Ca^{2+} , Mg^{2+} , sulfate⁻, organic acids, proteins⁻**
 - **deficiency related to allergies**
- 3) **ion movement :**
 - **permeability: membrane pore sizes/gates**
 - **concentration gradients**
 - **transport: passive diffusion, active transport**

Additions & Removals (1)

Avg. intake:	drink	60%*
	food	30%
	metab.**	10%
	(transfusion: variable)	
Avg. output:	urine	60%***
	skin/lungs	28%
	sweat	8%
	feces	4%

***reg by neural sys (thirst mechanism)**

****aerobic resp: $\text{gluc} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{ATP}$**

*****reg by renal & hormonal sys (ADH, aldosterone, renin)**

Thirst Review

↓ plasma vol or ↑ plasma osmol.



1) stim. osmoreceptors

2) ↓ saliva secretion -> dry mouth



stim hypothal. thirst center



thirst sensation (tolerable to intolerable)



fluid intake becomes important to imperative



↑ plasma vol &/or ↓ plasma osmol.

Thirst Notes

- 1) free food at happy hours**
 - **always salty**

- 2) thirst realization:**
 - **needs alert mind**
 - **absent in infants & trauma cases; dehydration risk**

- 3) immed. sated**
 - **with moist mouth**
 - **prevent excess fluid intake (hypotonic ECF)**

Diuresis

diuresis = urine prod. & release

↑ fluid intake → diuresis → ↑ excretion (urine)

diuretic mech. (hormonal & neural):

- 1) ↓ADH → ↓H₂O perm. → ↓H₂O reab.**
- 2) ↓aldosterone → ↓salt perm. → ↓H₂O reab.**
- 3) ↓ plasma conc. → osmoreceptors
→ hypothal. → pituitary → ↓ADH etc.**

Q: Why is happy hour food so salty?

ADH Review

Diagram stimulus -> response:

Stimulus

a) stimulatory

- 1) increase plasma osmolality**
- 2) increase Na⁺ in plasma**

b) inhibitory

- 1) decrease plasma vol.**
- 2) decrease BP**

Response

- decrease plasma osmolality**
- increase plasma volume**
- reduced urine**

Long Term Comp.

- long term response to Δ BP

\downarrow BP



a) \downarrow GFR* \rightarrow \downarrow Na⁺ filtration

b) \uparrow aldosterone & ADH release \rightarrow \uparrow Na⁺ reabsorp.



\uparrow Na⁺ conc. in plasma



\uparrow water retention in plasma



\uparrow plasma vol



\uparrow BP

$$*NFP = HP_g - (HP_c + OP_g) \quad (HP_g = BP)$$

Dehydration

Causes:

- a) **insuff water intake: insuff. drinking**
- b) **excess water loss: sweat, diarrhea**
- c) **diabetes insipidus: dilute urine**
- d) **renal failure: urea retention**

Effects:

- a) **dry skin & tongue, sunk eyes**
- b) **↓ plasma vol -> ↓BP -> circ. shock -> death**
- c) **fluid shift from ICF -> IF -> hyper ECF ;
cell shrinks -> brain, delirium or coma**

Water Intox.

Causes:

- a) **excess or rapid water intake: excess drinking**
- b) **renal failure: unable to prod. dilute urine**
- c) **stress: incr. ADH -> incr. water retention**

Effects:

- a) **edema**
- b) **↑ plasma vol -> ↑BP -> circ. shock -> death**
- c) **fluid shift to IF -> ICF due to hypo ECF;
cell expands -> brain, delirium or coma**