

Poruchy acidobazické rovnováhy při CRRT

Příběh citrátu

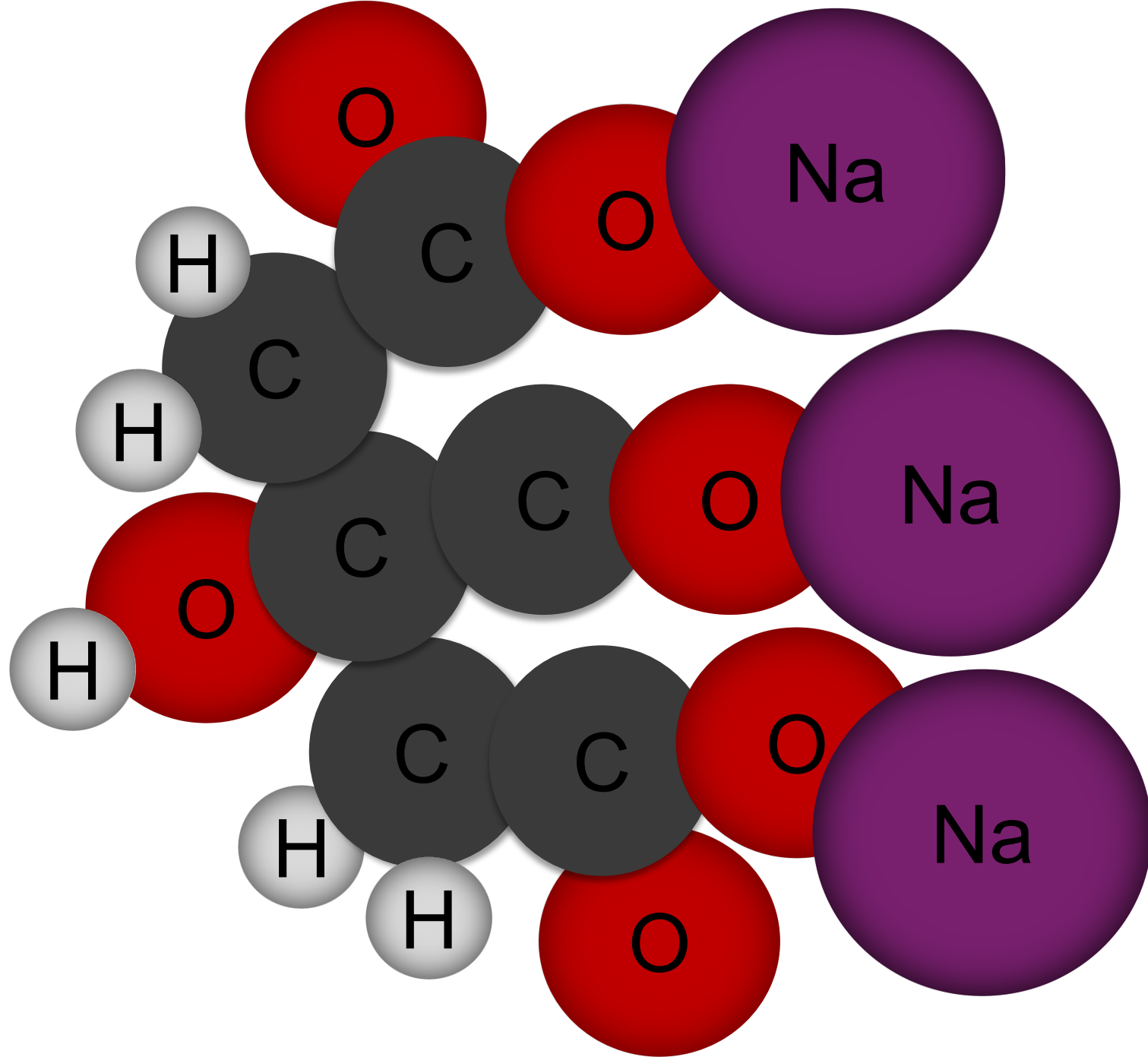
Milan Kratochví, IKK FN Brno a MU, KDAR FN Brno

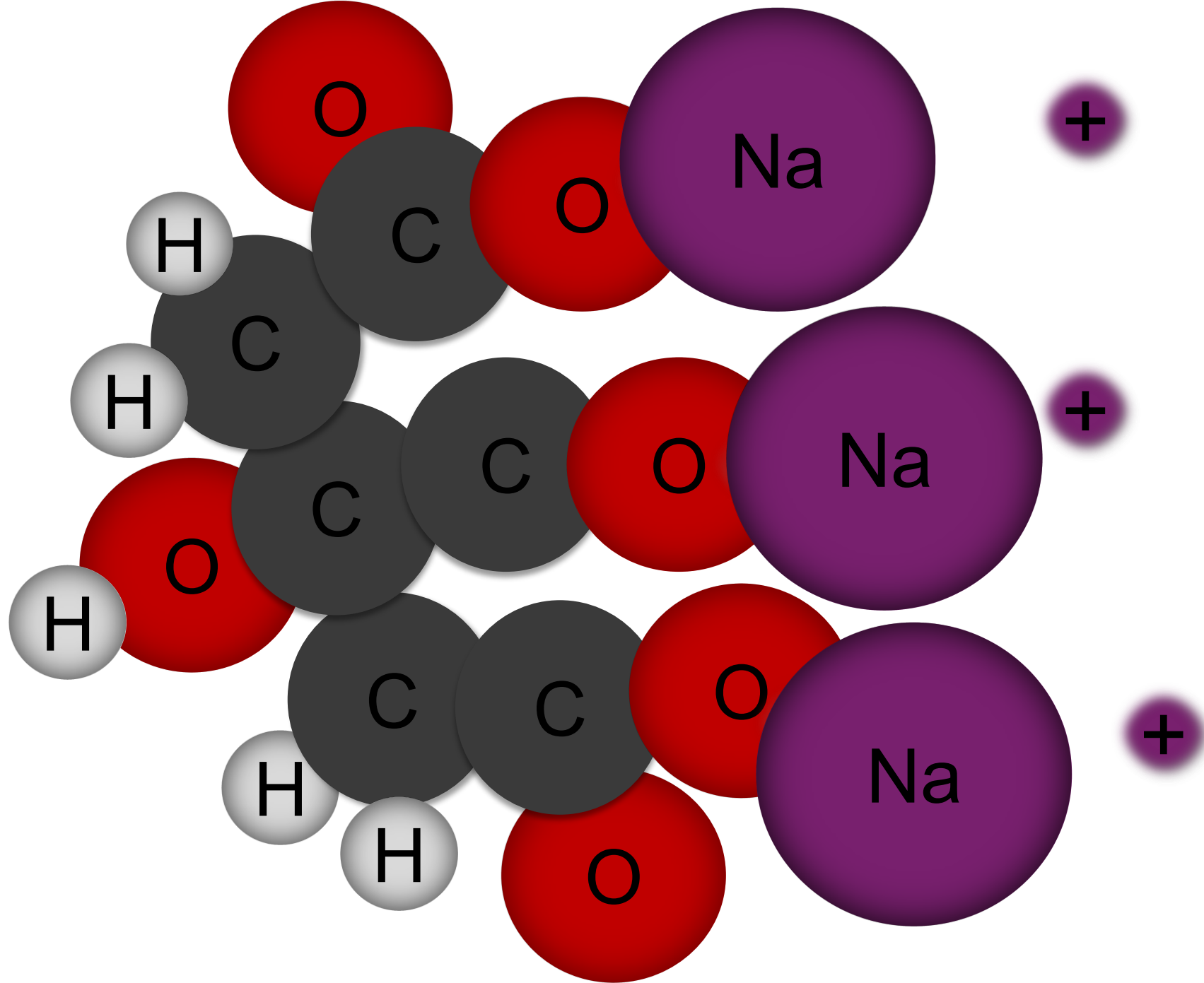
Plot (děj, fabula)

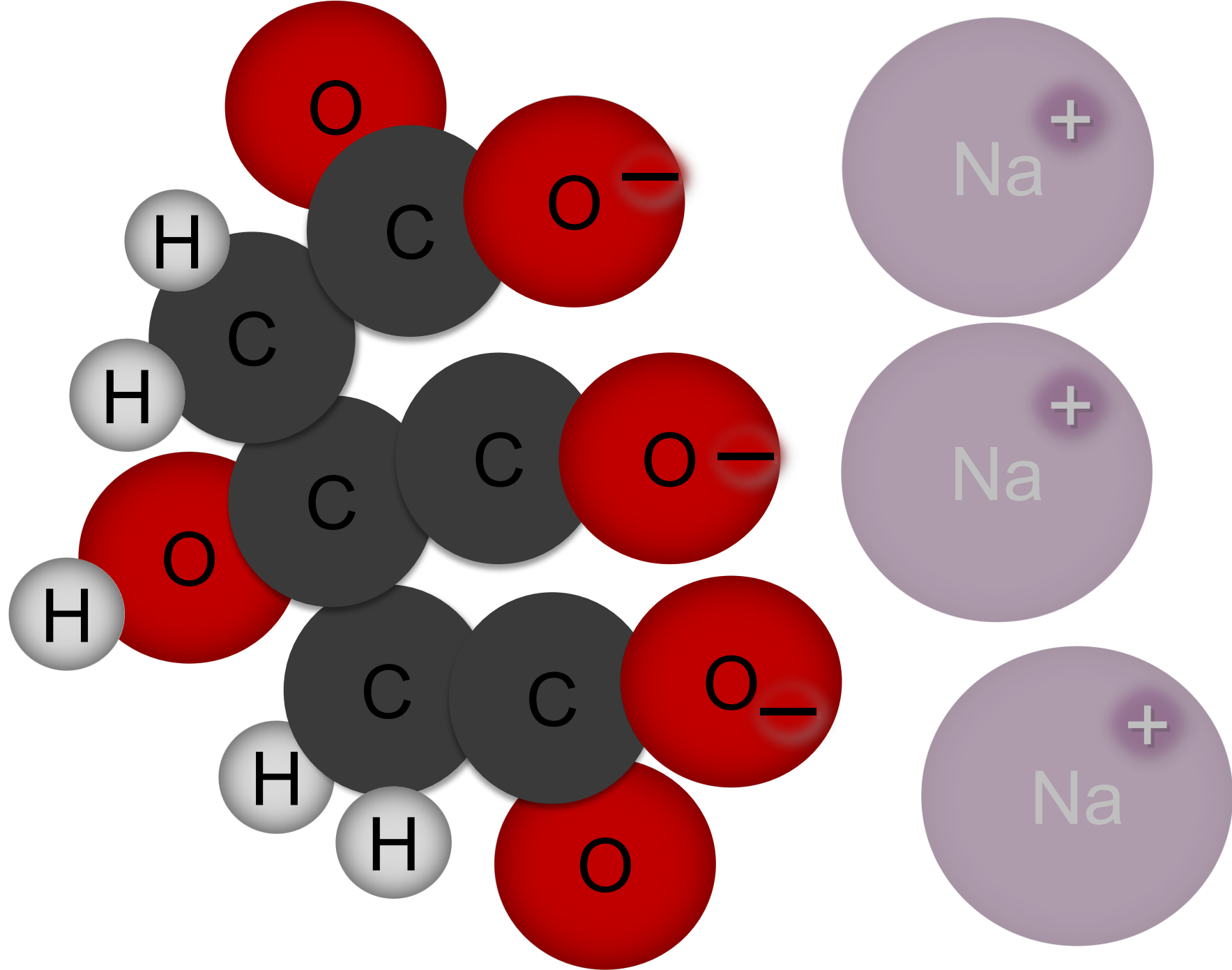
- Představení hlavního hrdiny – citrátu
- Jeho metabolismus a patofyziologie za CRRT
- Různý pacient, různé poruchy ABR
- Jak je zjistit, předejít a postavit se jim

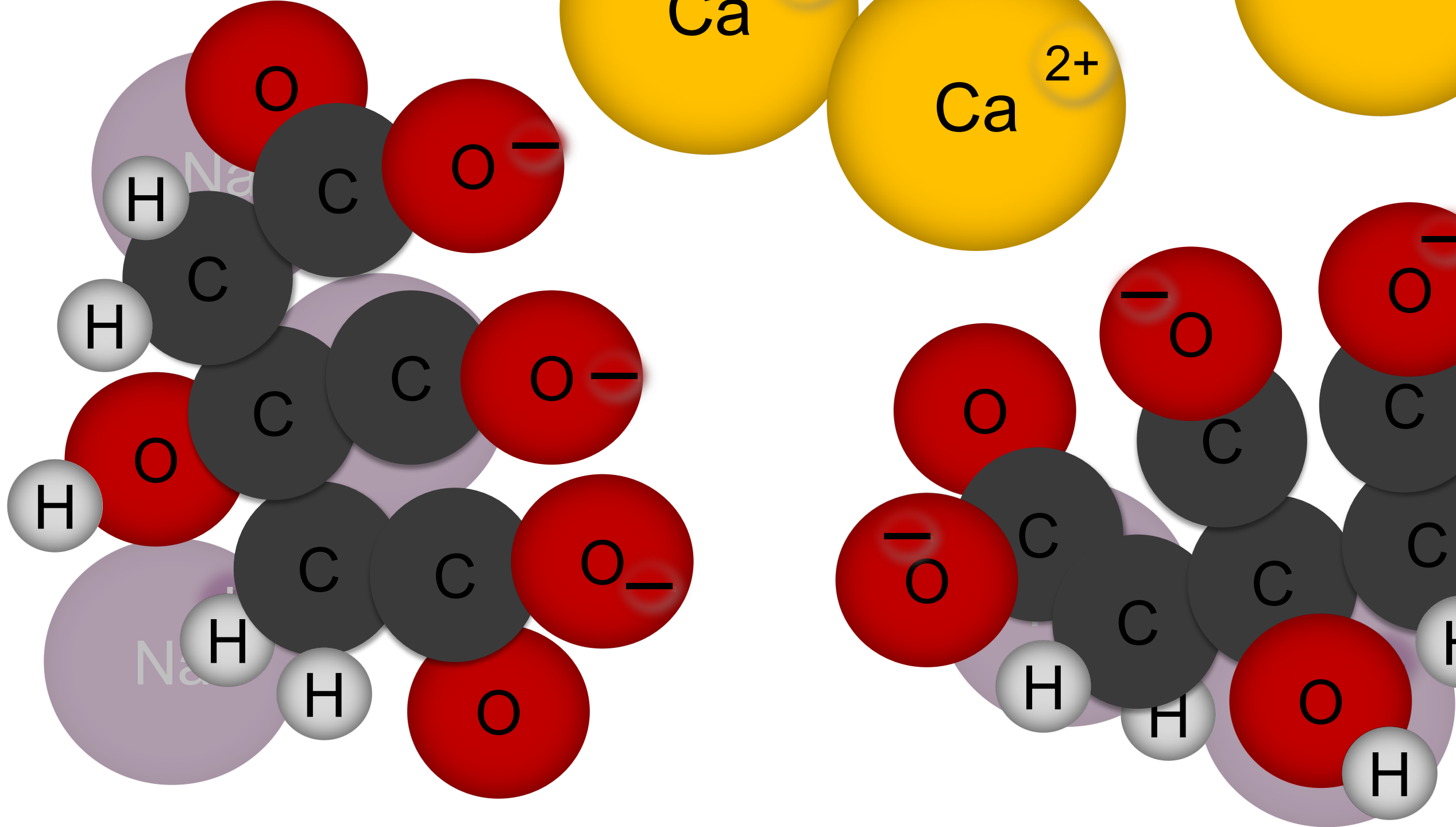
Představení hlavního hrdiny – citrátu

Farmakologie citrátu









Efluent



CVVH 35-50%
CVVHD 40-60%

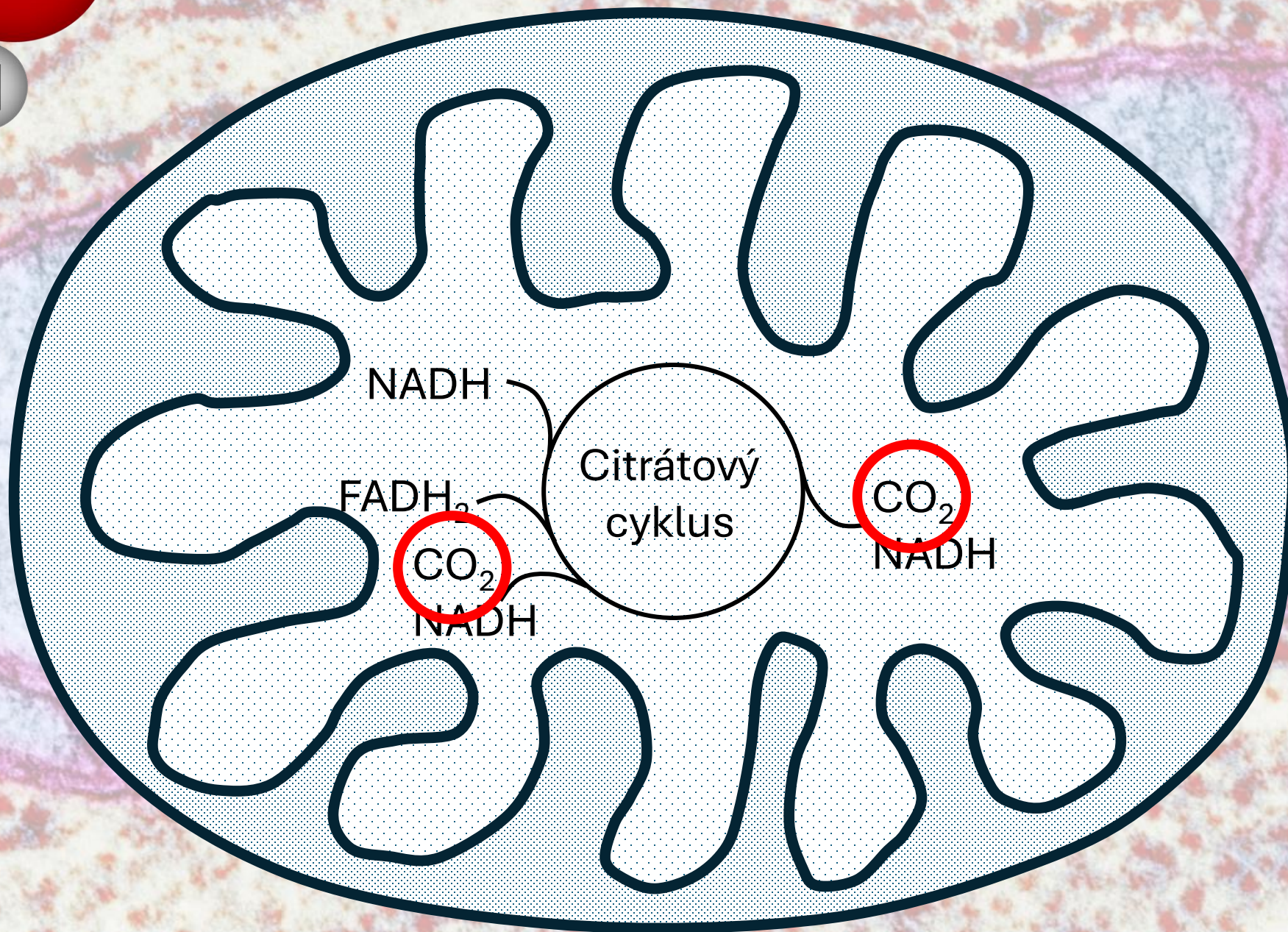
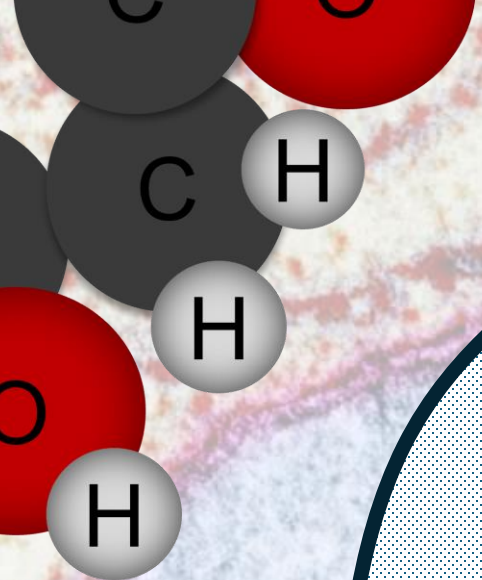
Kapilára

Lumen Kapiláry

Zpět do oběhu

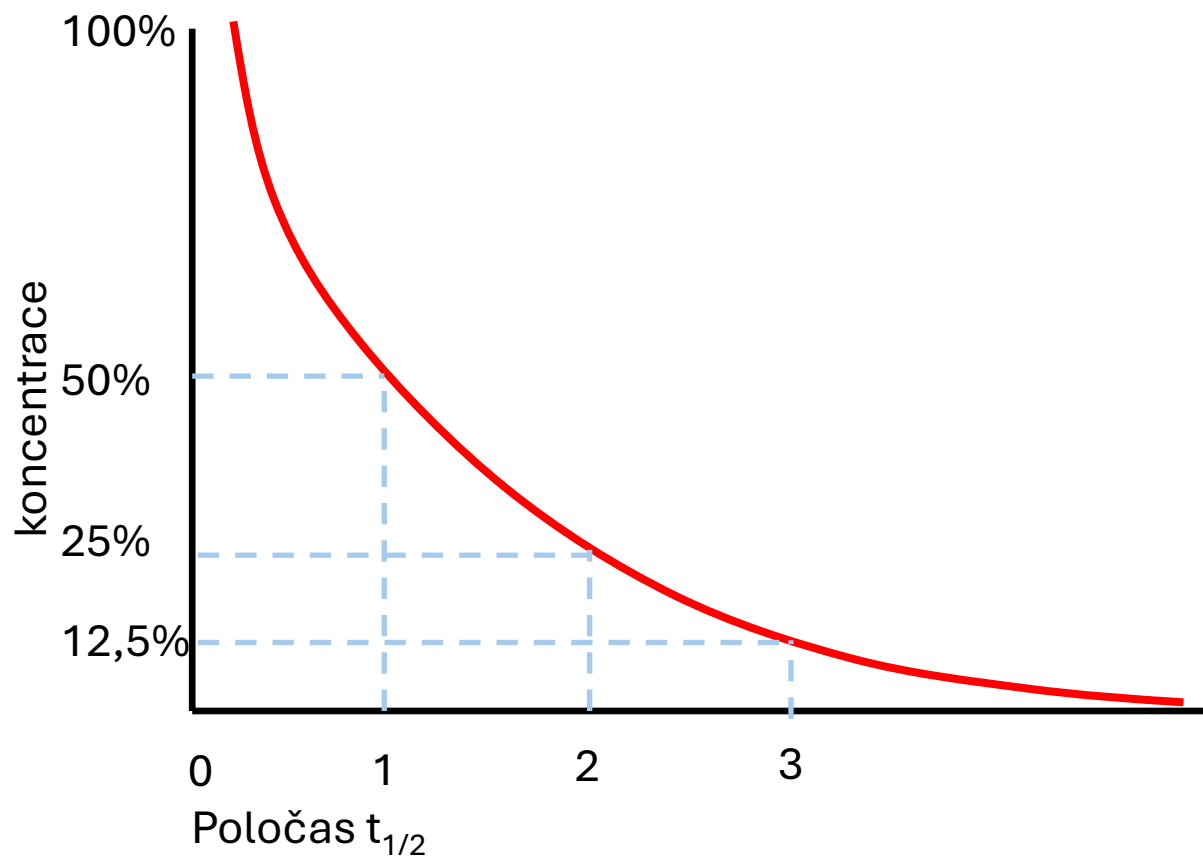


CVVH 50-65%
CVVHD 40-60%

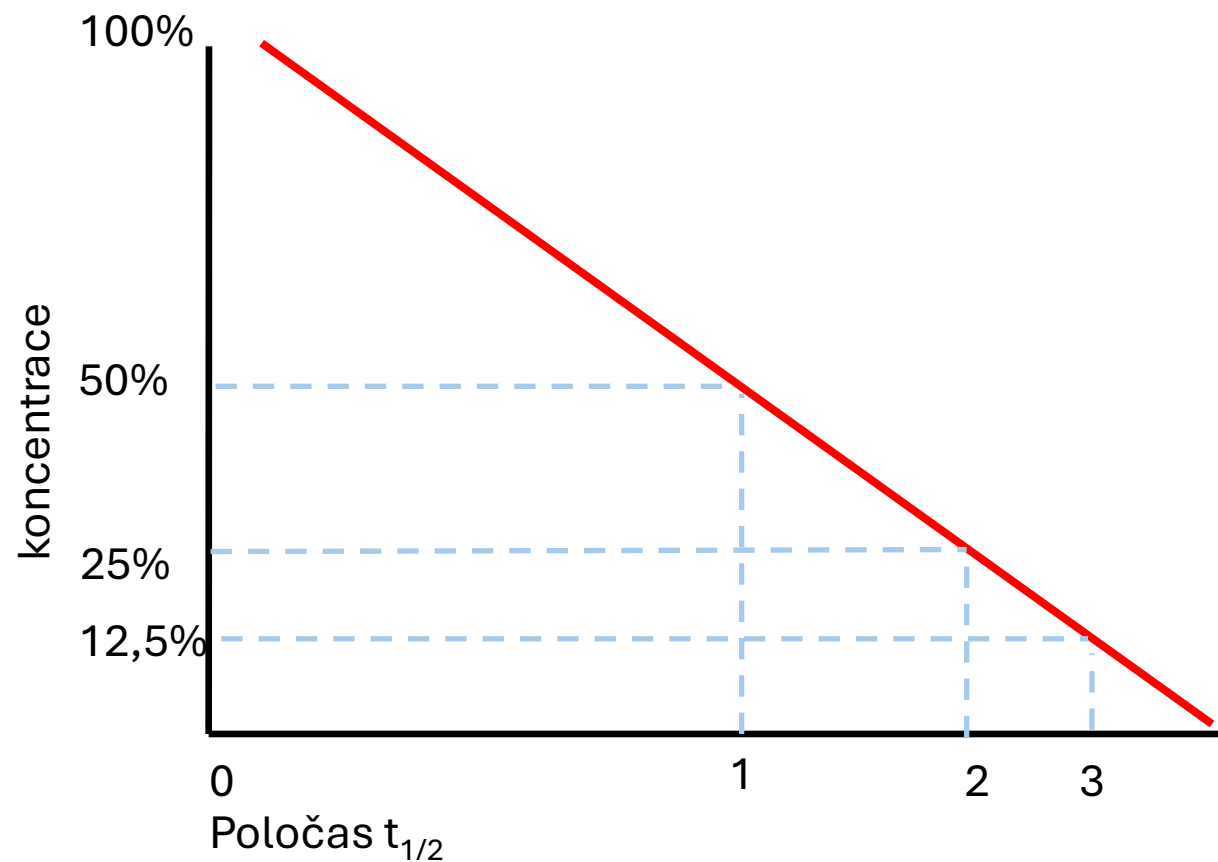


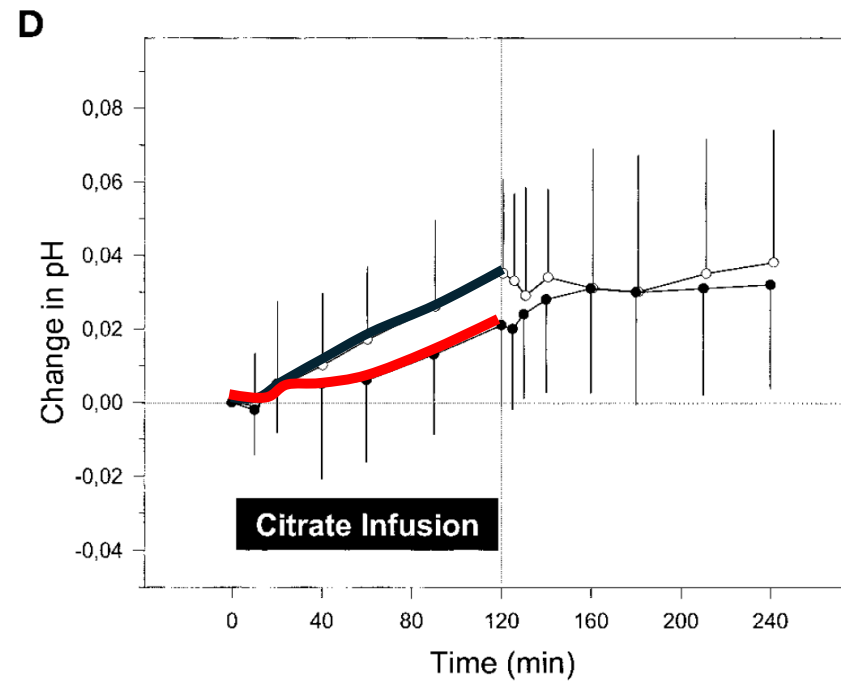
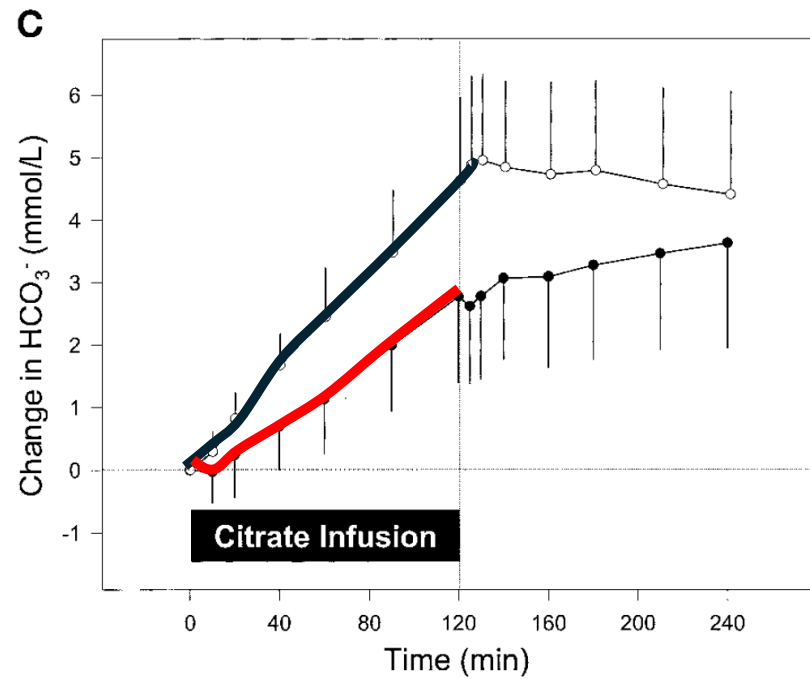
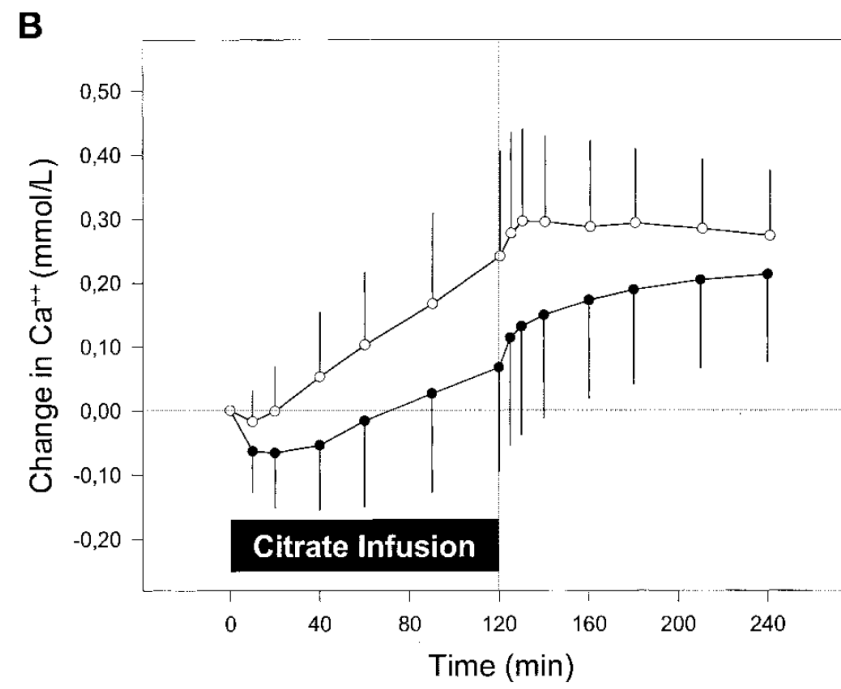
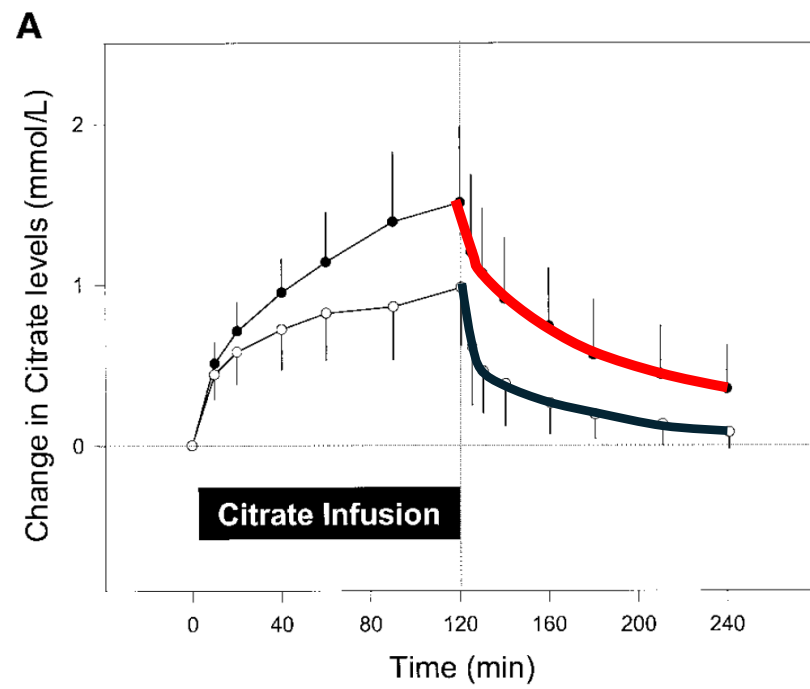
Farmakokinetika citrátu

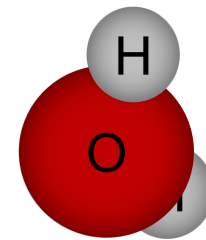
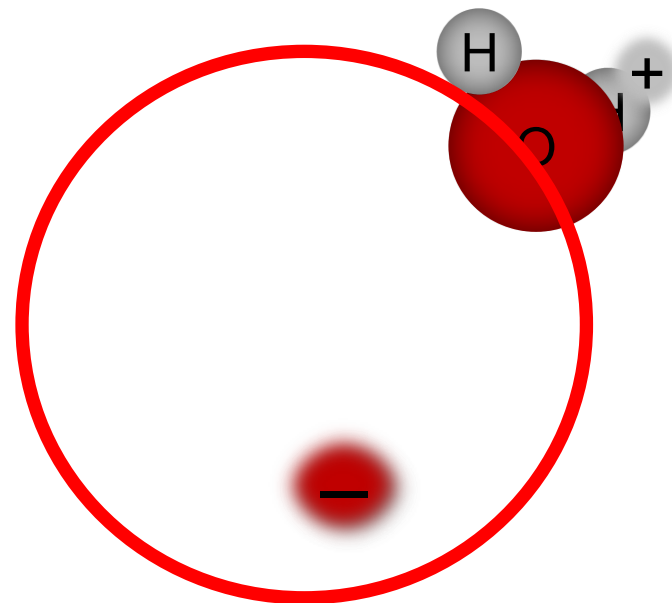
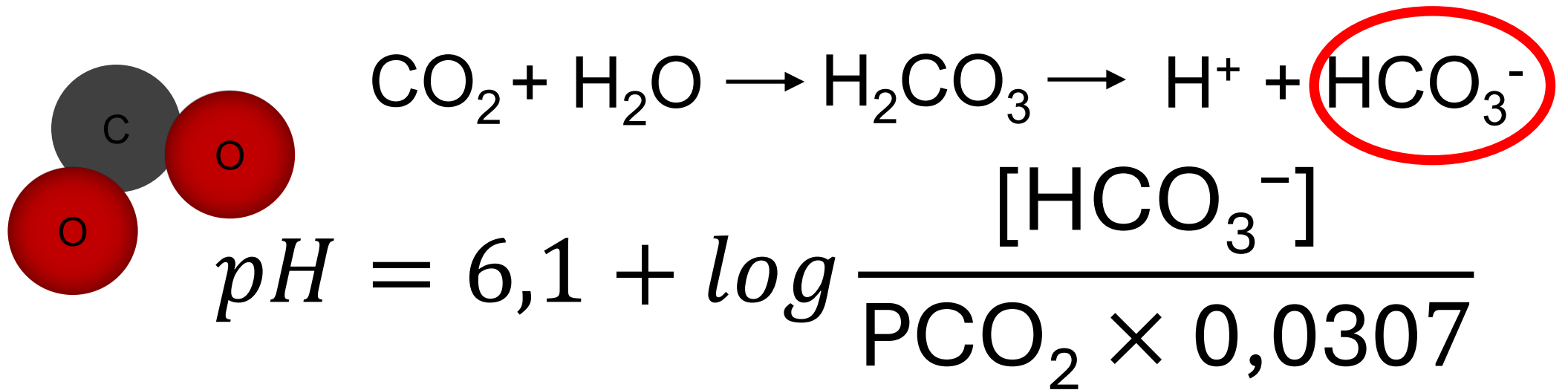
Kinetika prvního řádu



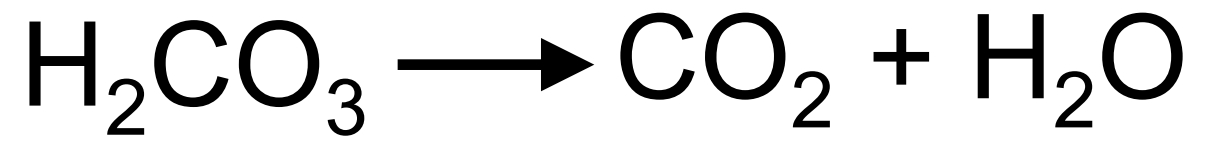
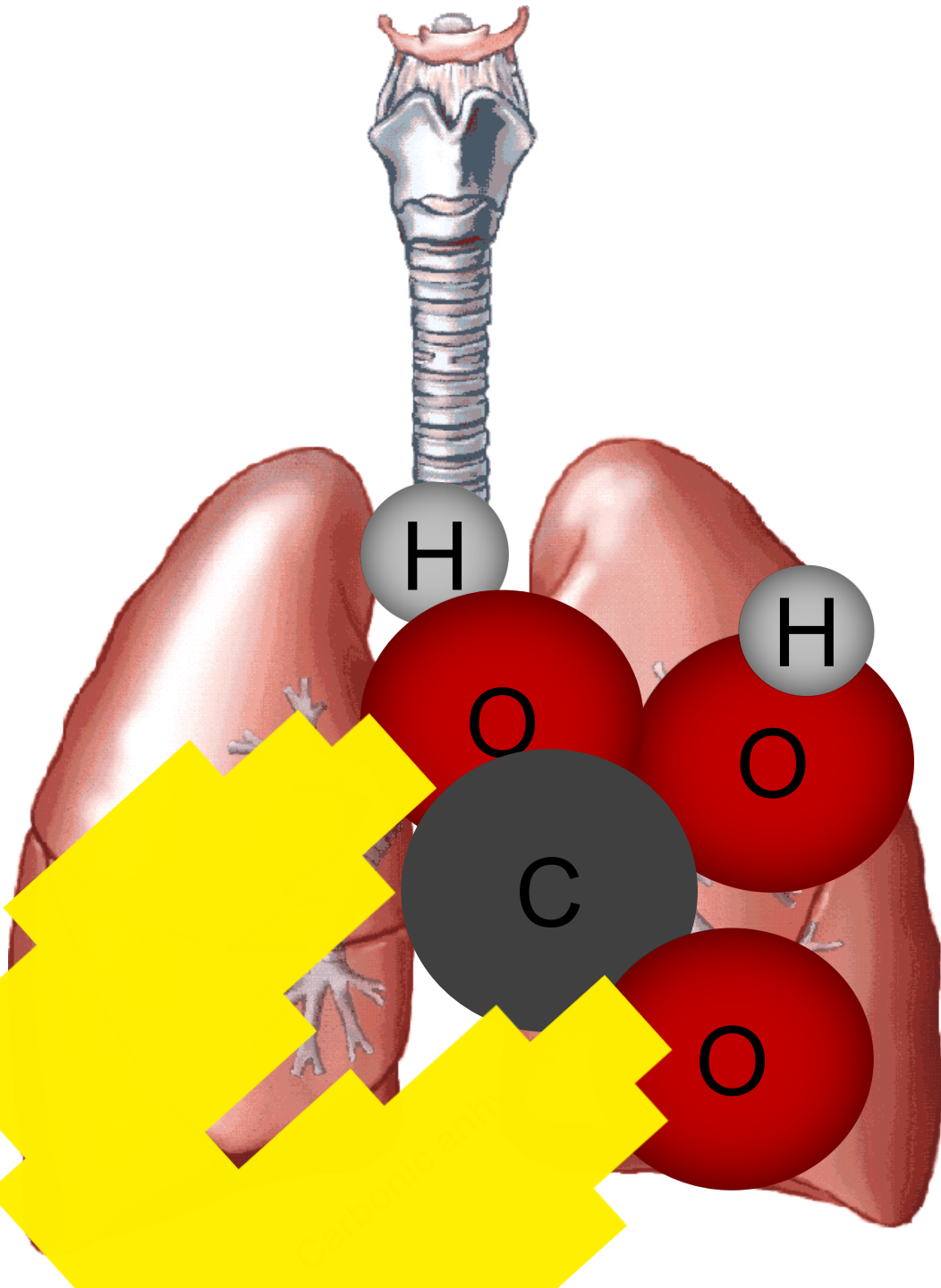
Kinetika nultého řádu

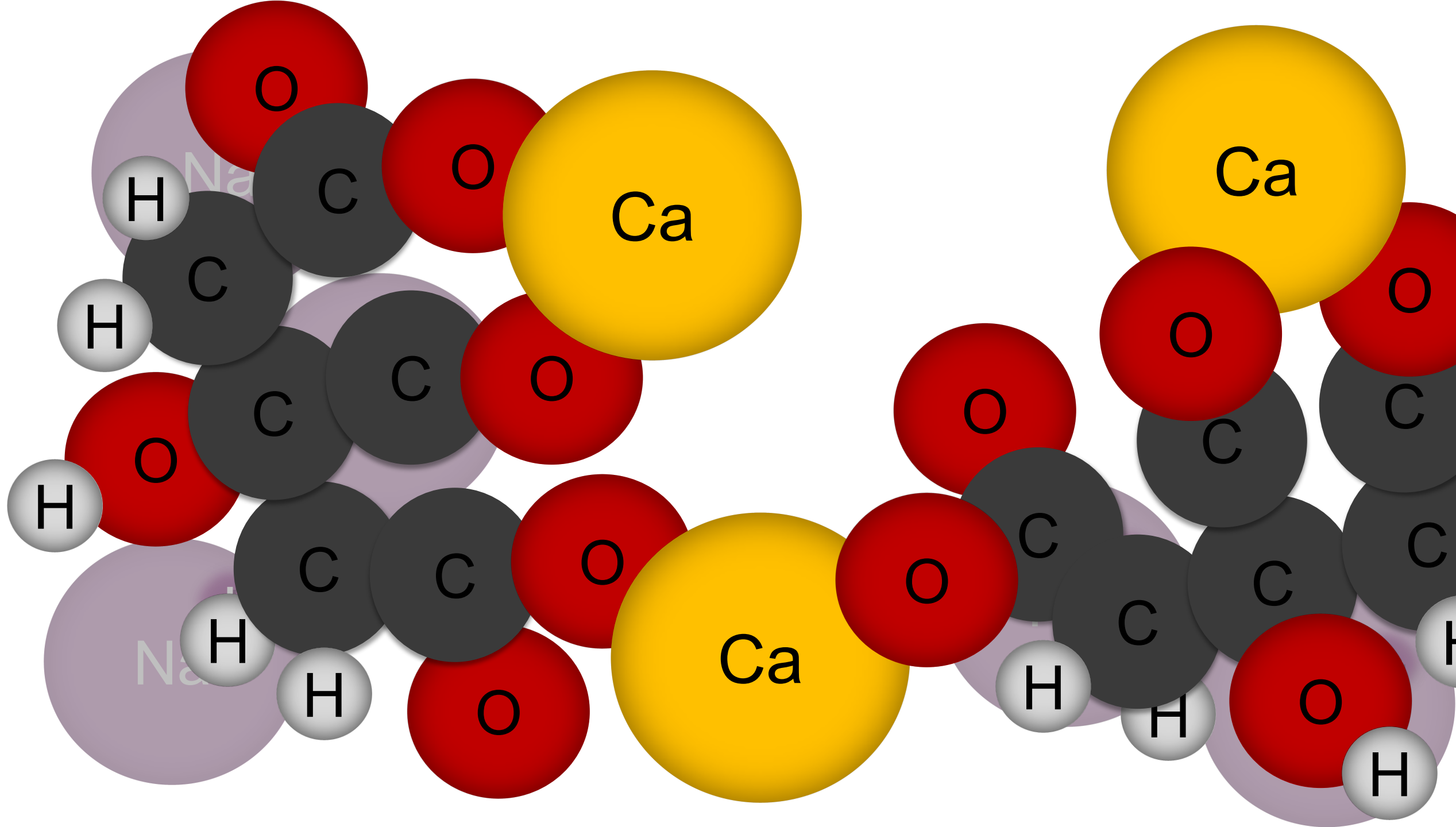


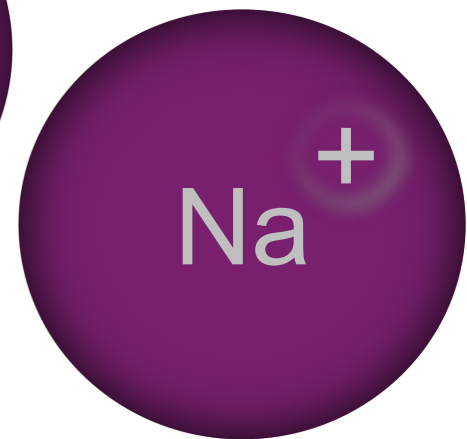
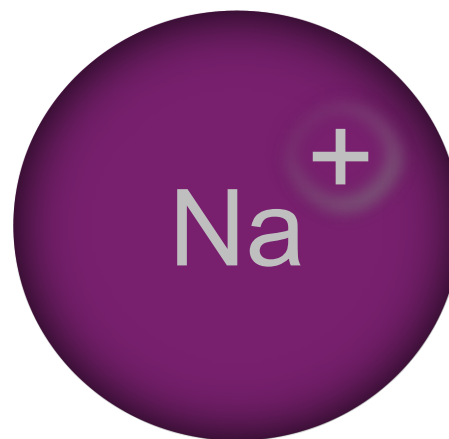
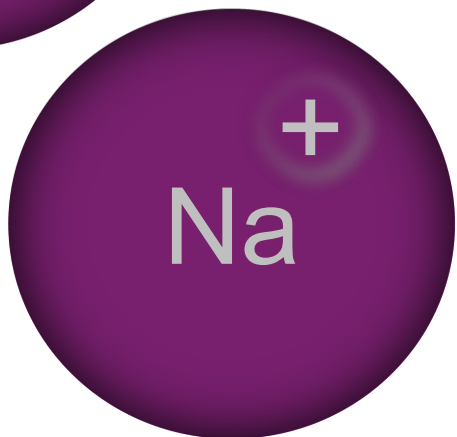


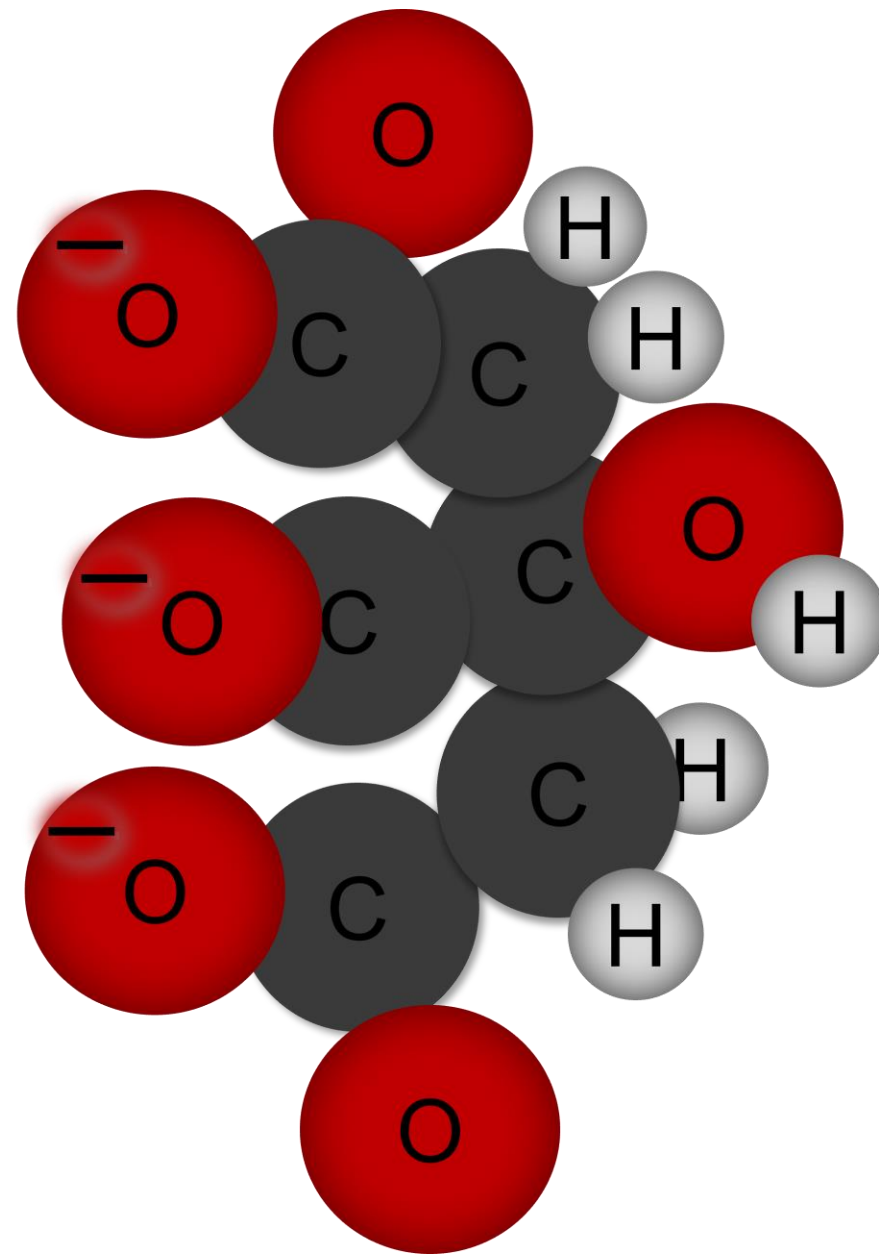
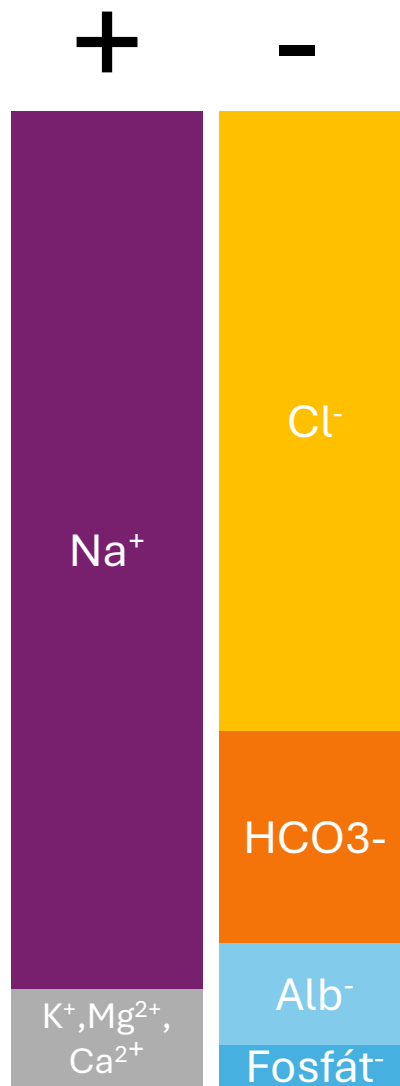
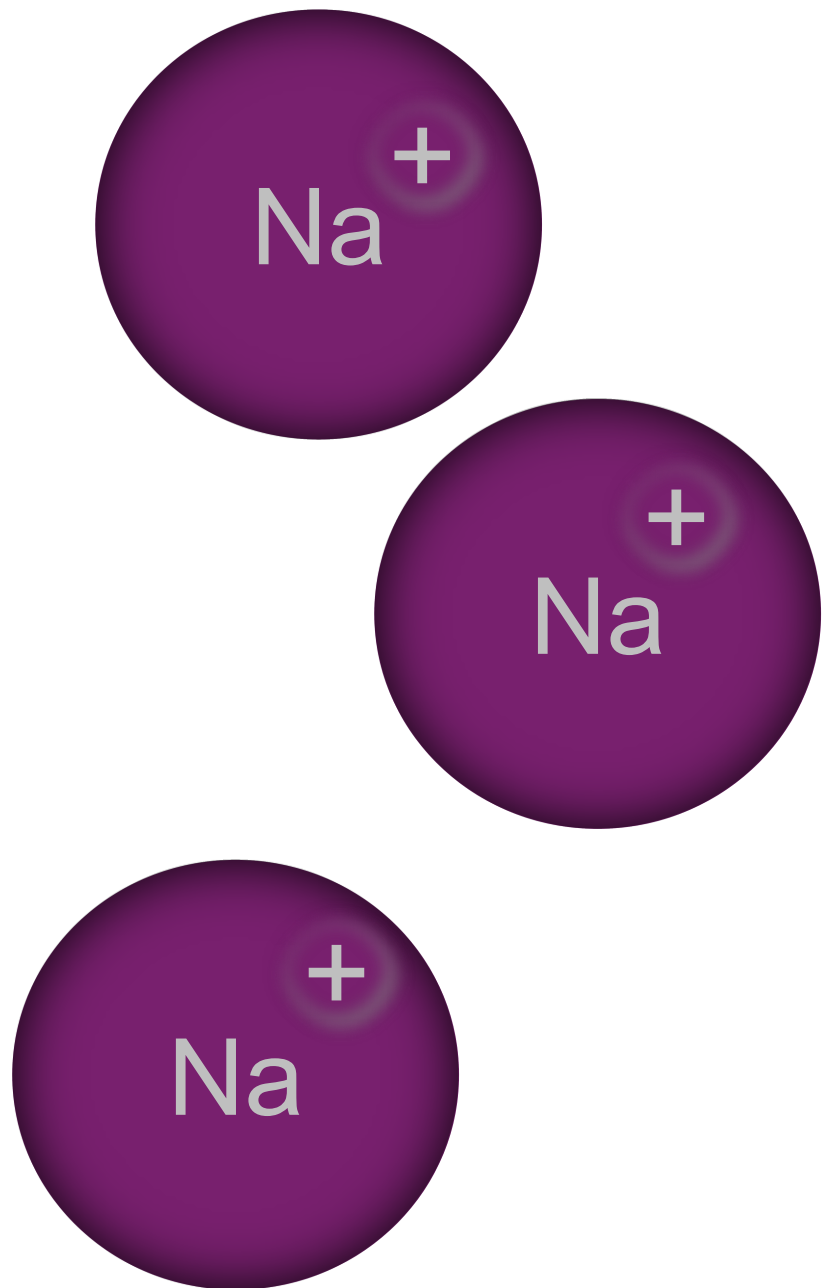


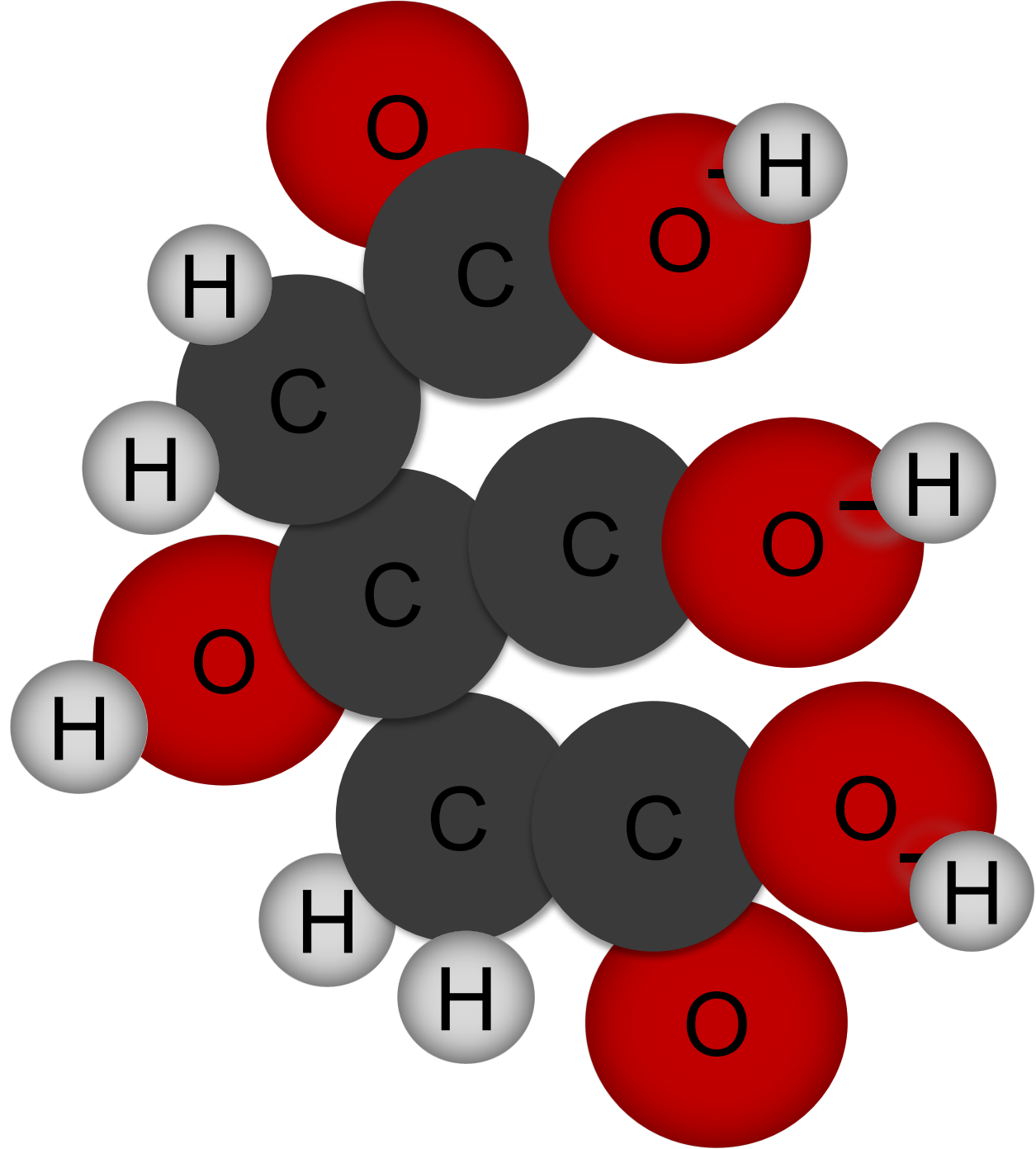
Respirační acidóza







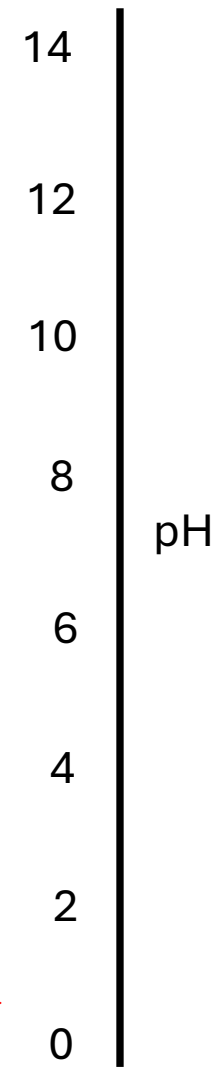




+

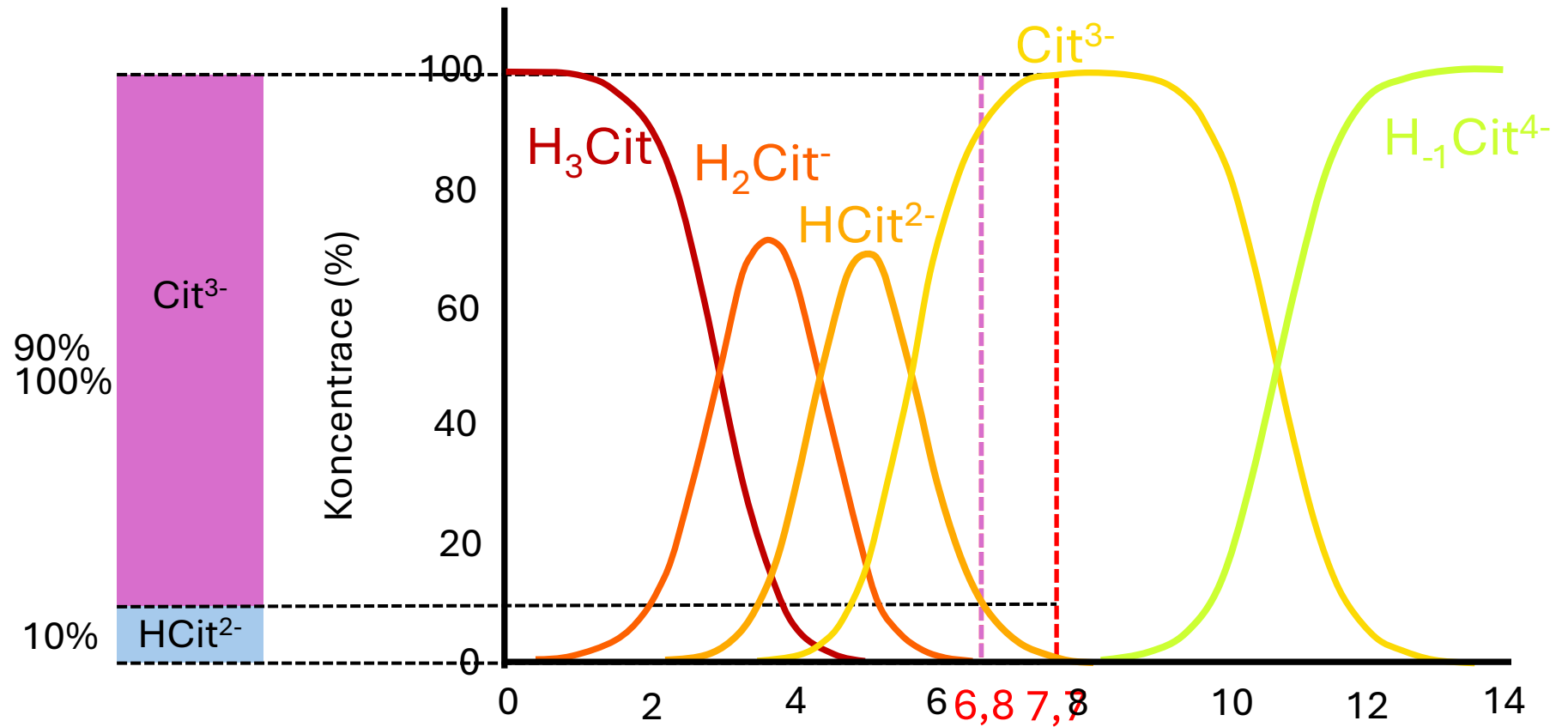
+

+



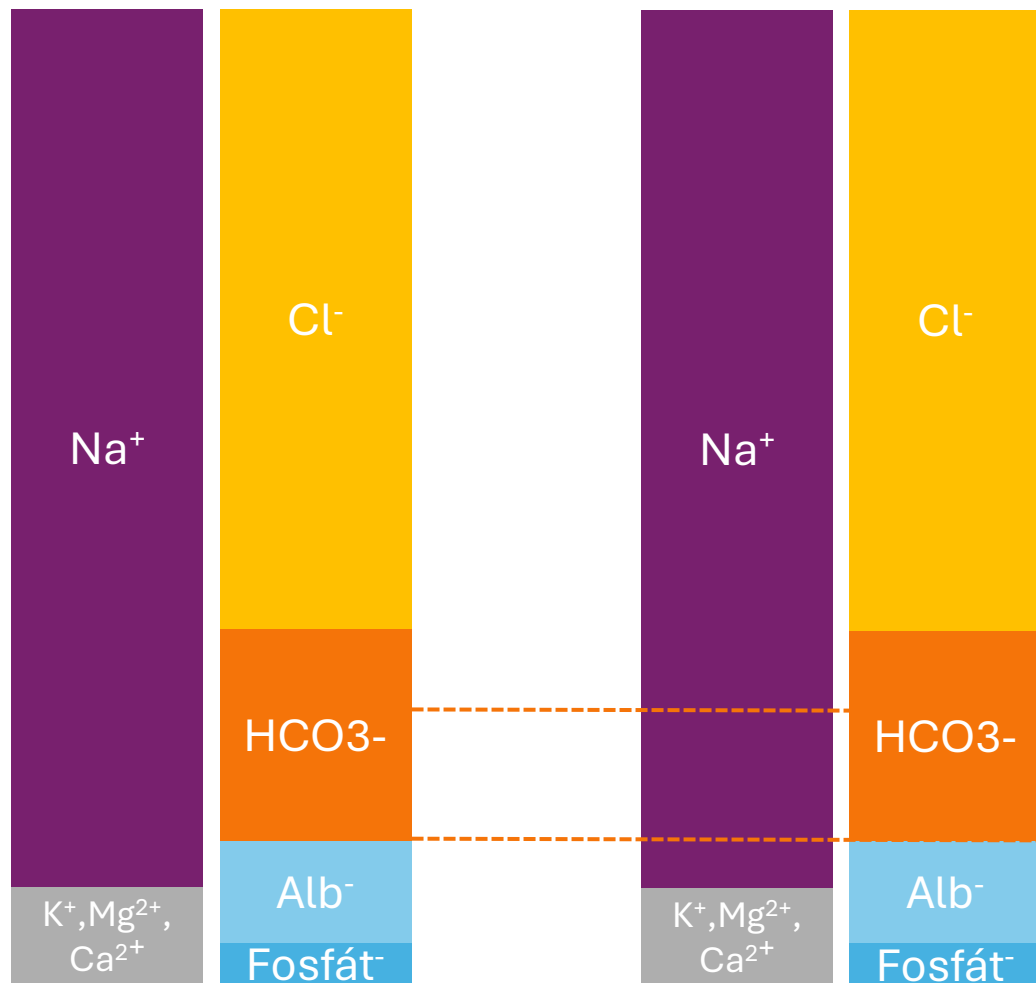
Disociace citrátu

- $pK_{a1} \sim 3.13$
- $pK_{a2} \sim 4.76$
- $pK_{a3} \sim 6.40$



Akumulace citrátu

Metabolická acidóza s vysokým SID

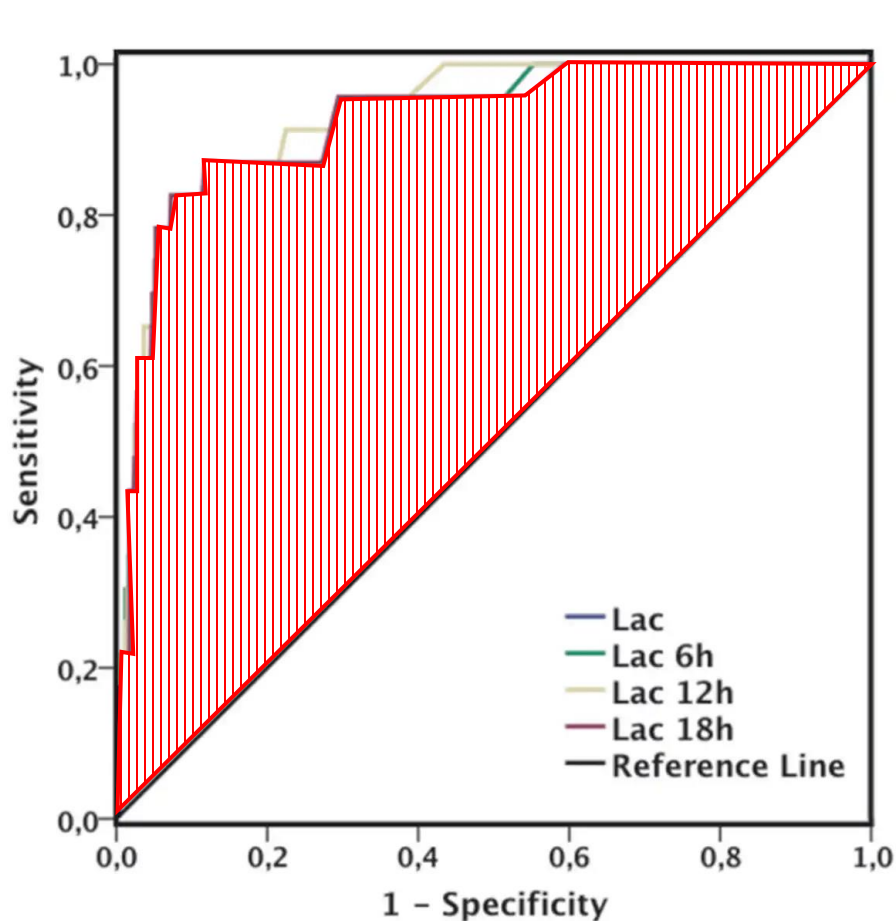


↓ pH

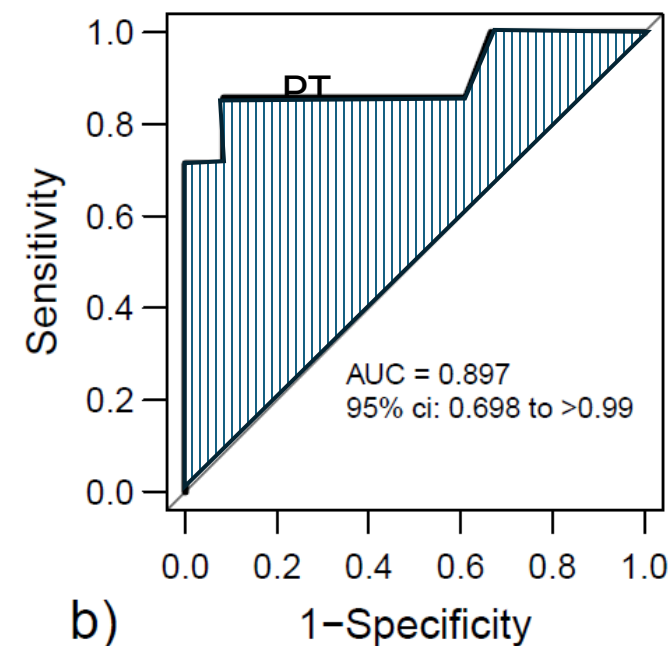
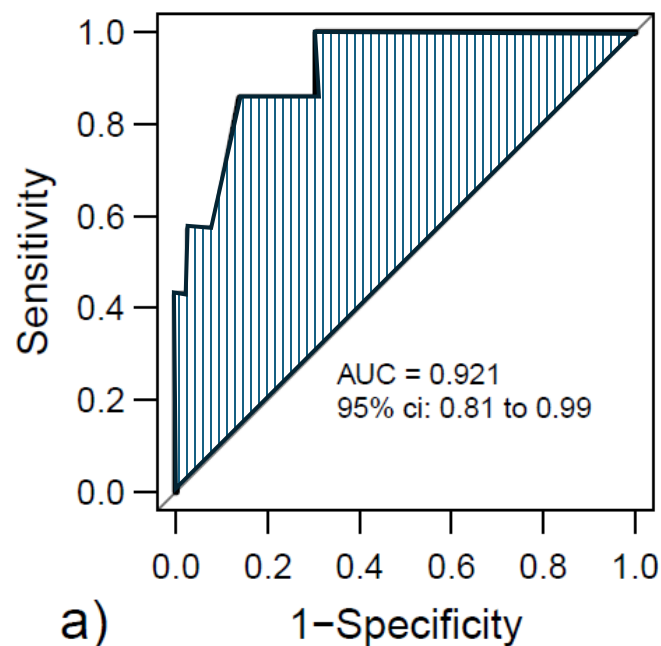
Citrate accumulation

- Poměr $\text{Ca}_{\text{tot}}/\text{Ca}^{2+}$ - vztah mezi vápníkem vázaným na proteiny a vápníkem chelatovaným citrátem na straně jedné a volným vápníkem na straně druhé, významně koreluje s koncentracemi citrátu jak u pacientů s cirhózou ($R = 0,50$; $p < 0,001$), tak u pacientů bez cirhózy. ($R = 0,62$, $p = 0,001$).
- Hladina laktátu koreluje s akumulací citrátu v důsledku narušeného Krebsova cyklu..

Variable	Threshold Values (mmol/L)	Sensitivity, % (95% CI)	Specificity, % (95% CI)	Positive Predictive Value (%)	Negative Predictive Value (%)
Lactate before regional citrate anticoagulation	2.29	79.2 (57.9–92.9)	66.7 (63.7– 69.5)	5.2	99.3
Lactate at 6 hr	4.16	83.3 (62.6–95.3)	85.9 (83.7–88.0)	12.1	99.6
Lactate at 12 hr	3.94	87.5 (67.6–97.3)	88.4 (86.3–90.3)	14.9	99.7
Lactate at 18 hr	3.72	83.3 (62.6–95.2)	89.9 (87.9–91.7)	16.0	99.6



Khadzhynov, Crit Care Med 2017; 45:e941–e946)



Schultheiß et al. Critical Care 2012, 16:R162

Metabolická acidóza z nedostatečné dávky citrátu

MAC se sníženým SID

Each litre of the ready-to-use solution contains:

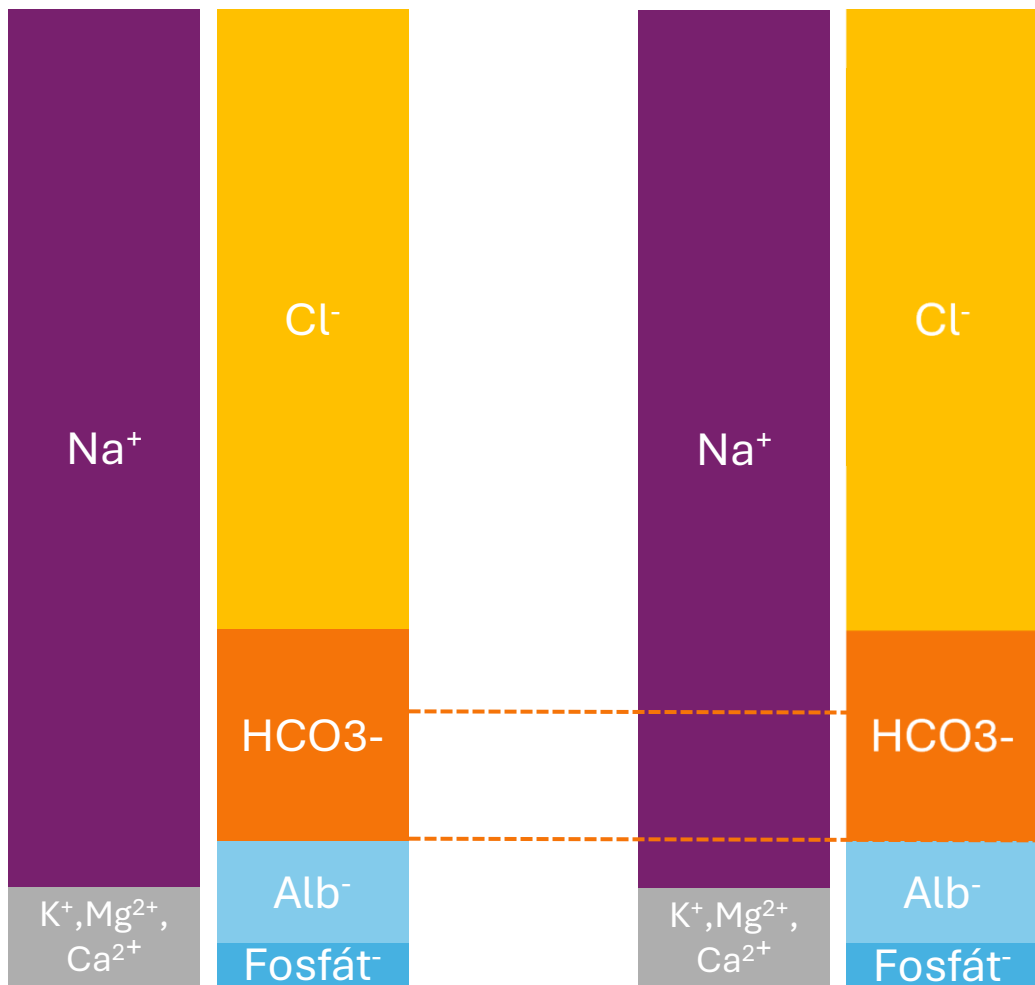
Sodium chloride	6.604	g/L
Sodium hydrogen carbonate	1.68	g/L
Potassium chloride	0.1491	g/L
Magnesium chloride hexahydrate	0.1525	g/L
Glucose monohydrate	1.1	g/L
Theoretical osmolarity	278	mOsm/L
pH	7.0 – 7.6	

Excipients: Water for injections, hydrochloric acid 25%

Ion and glucose concentration in each litre of the ready-to use solution:

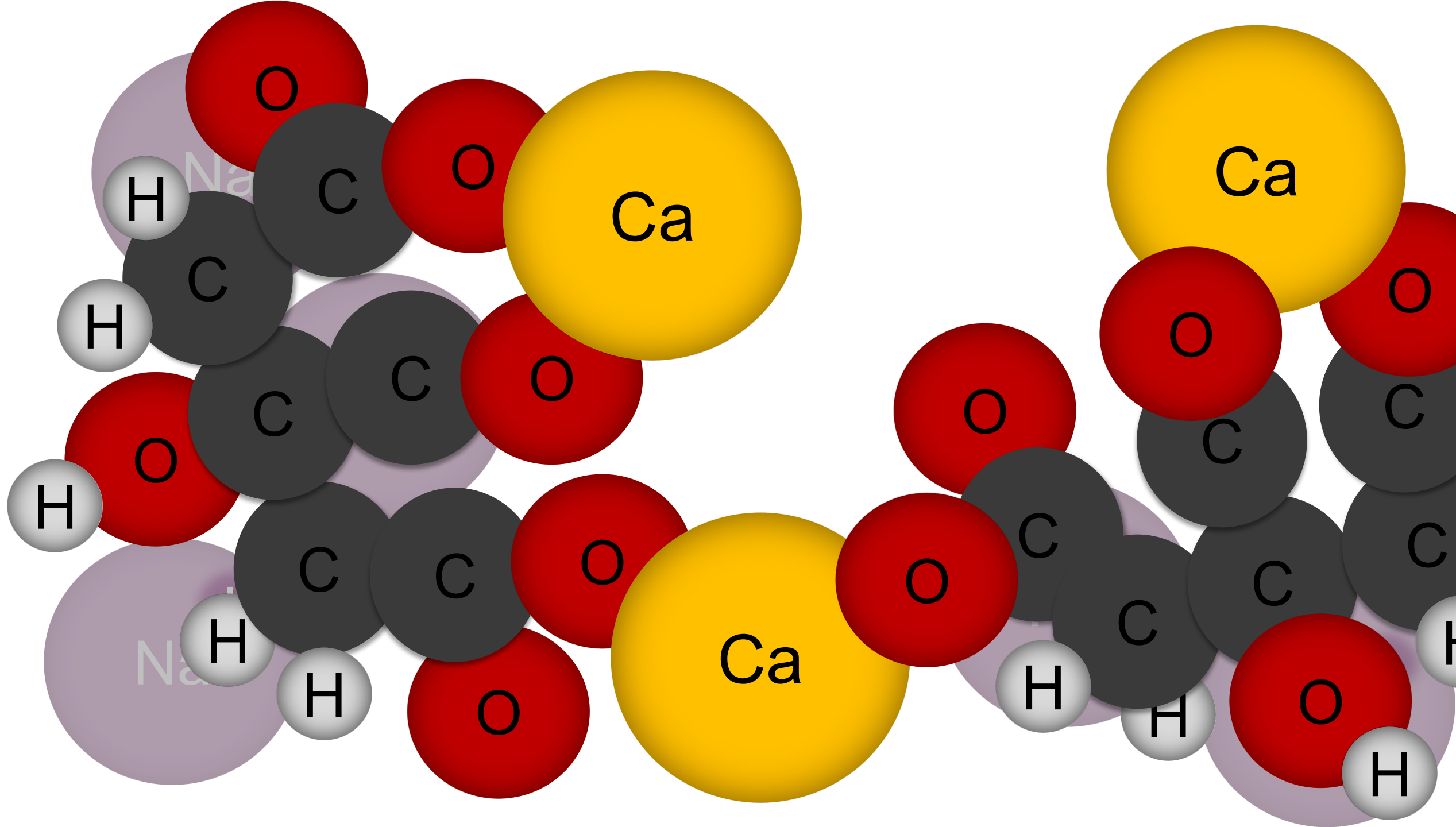
K ⁺	2	mmol/L
Na ⁺	133	mmol/L
Mg ²⁺	0.75	mmol/L
Cl ⁻	116.5	mmol/L
HCO ₃ ⁻	20	mmol/L
Glucose, anhydrous	5.55	mmol/L

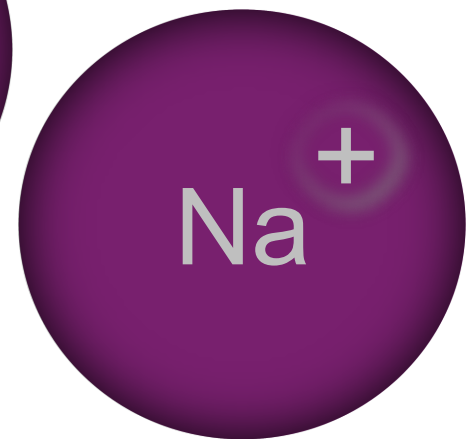
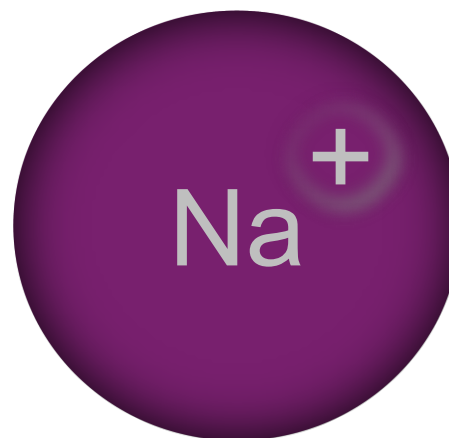
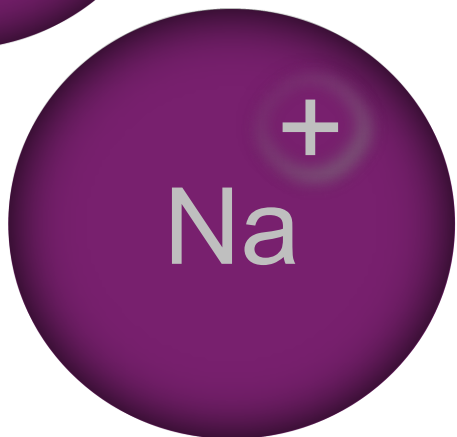
<https://freseniusmedicalcare.com/cs-cz/odborna-verejnost/akutni-terapie-multiorganova-odpora/akutni-lecebne-systemy/spotrebn-material-a-roztoky/>

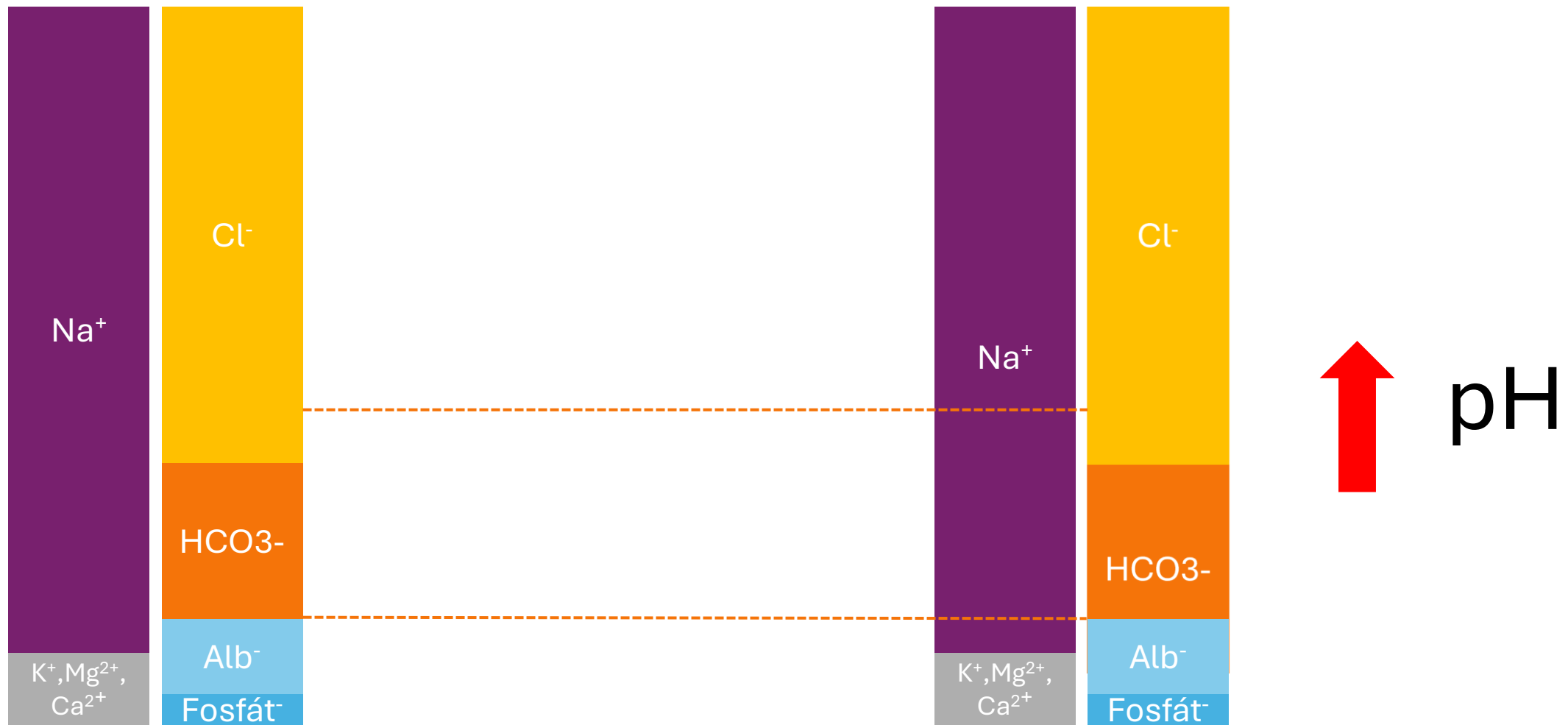


↓ pH

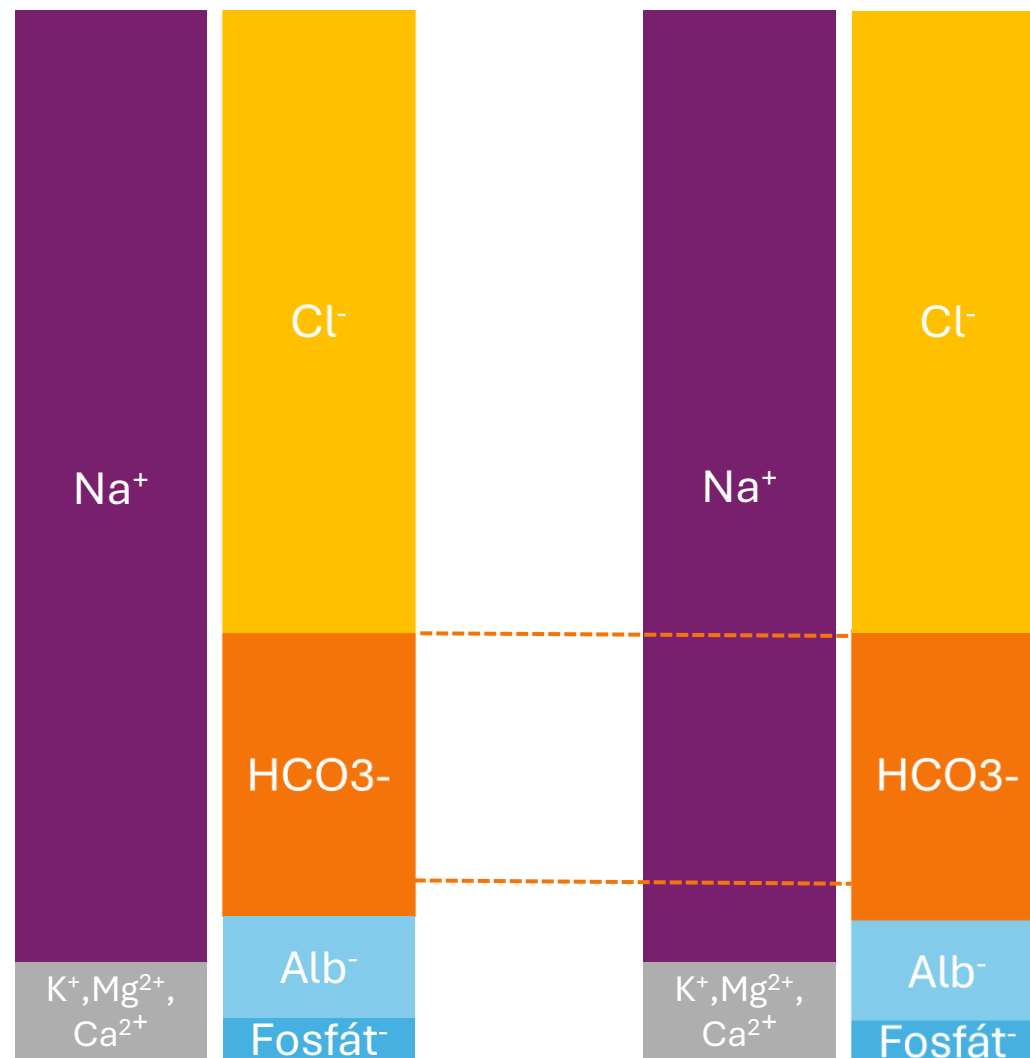
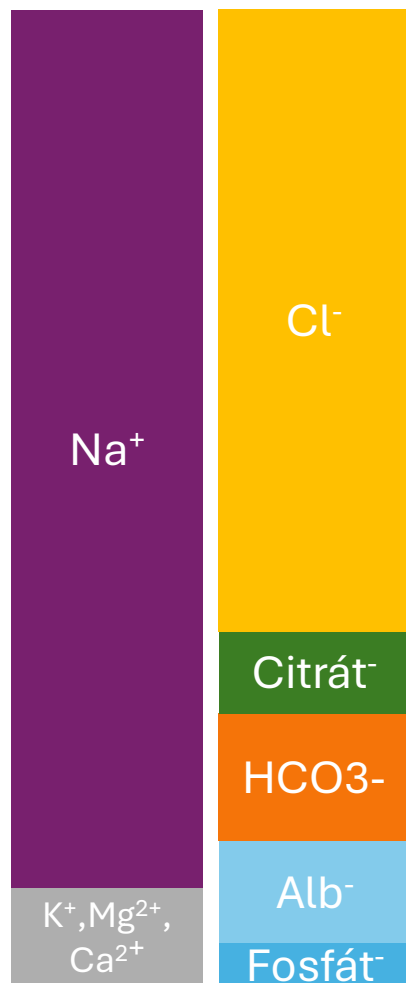
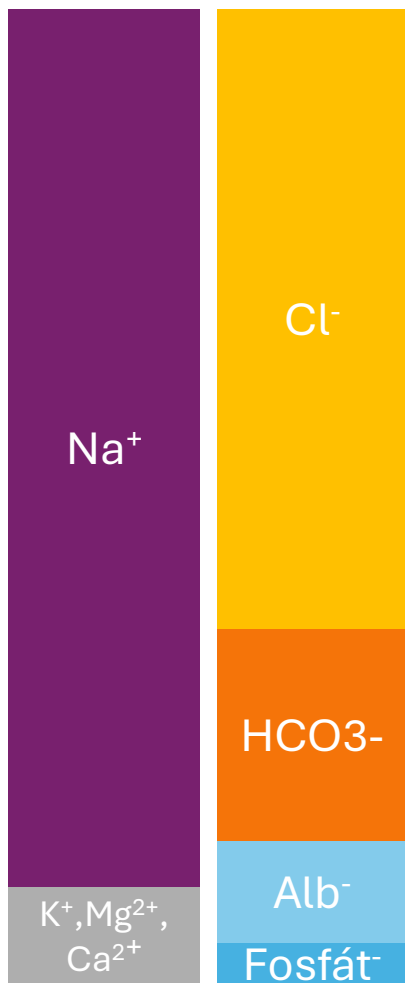
Metabolická alkalóza z
předávkování (overload) citrátem





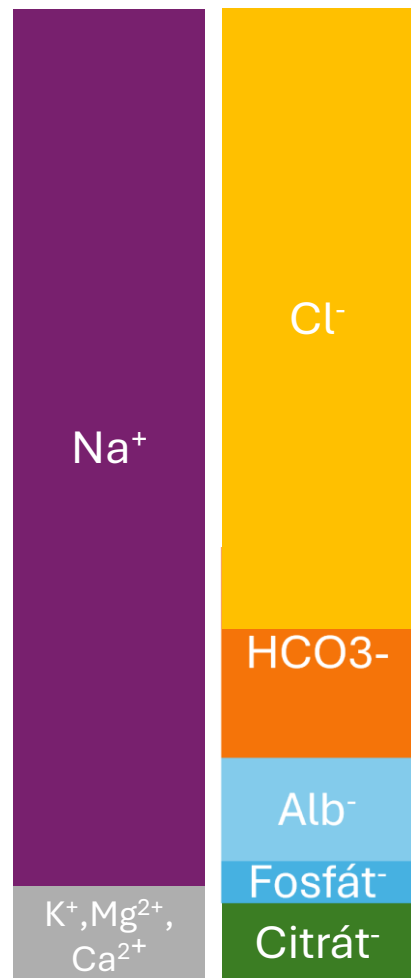


Kombinace metabolických poruch

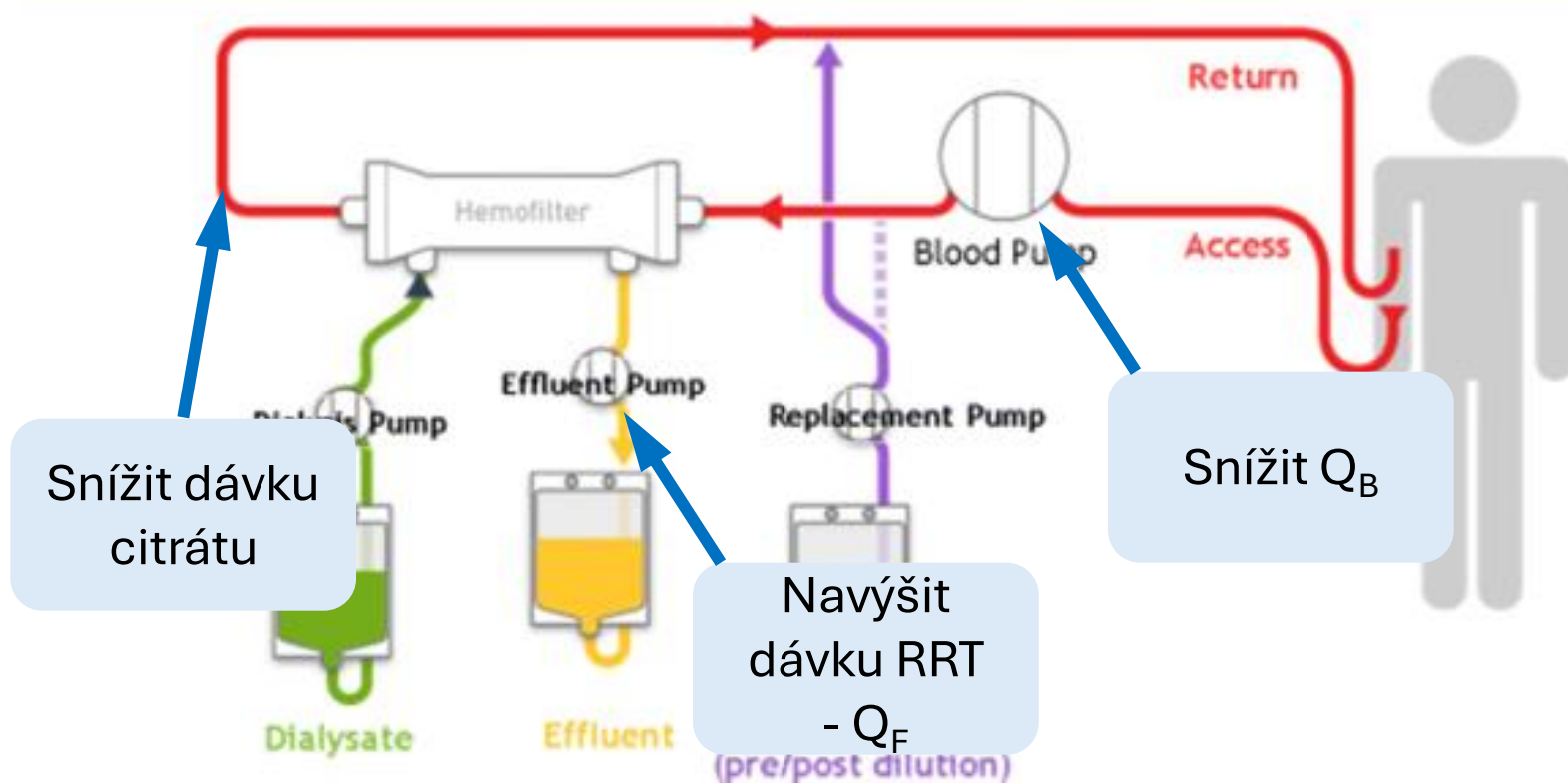


Léčba poruch ABR při RRT

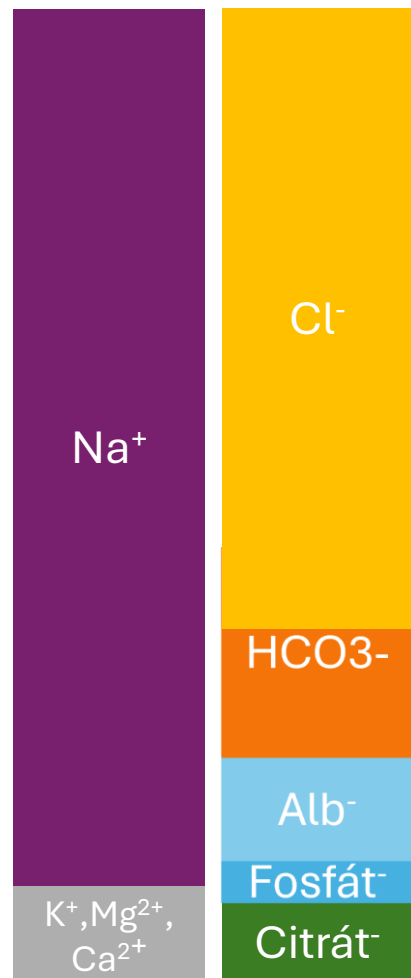
MAC z akumulace citrátu



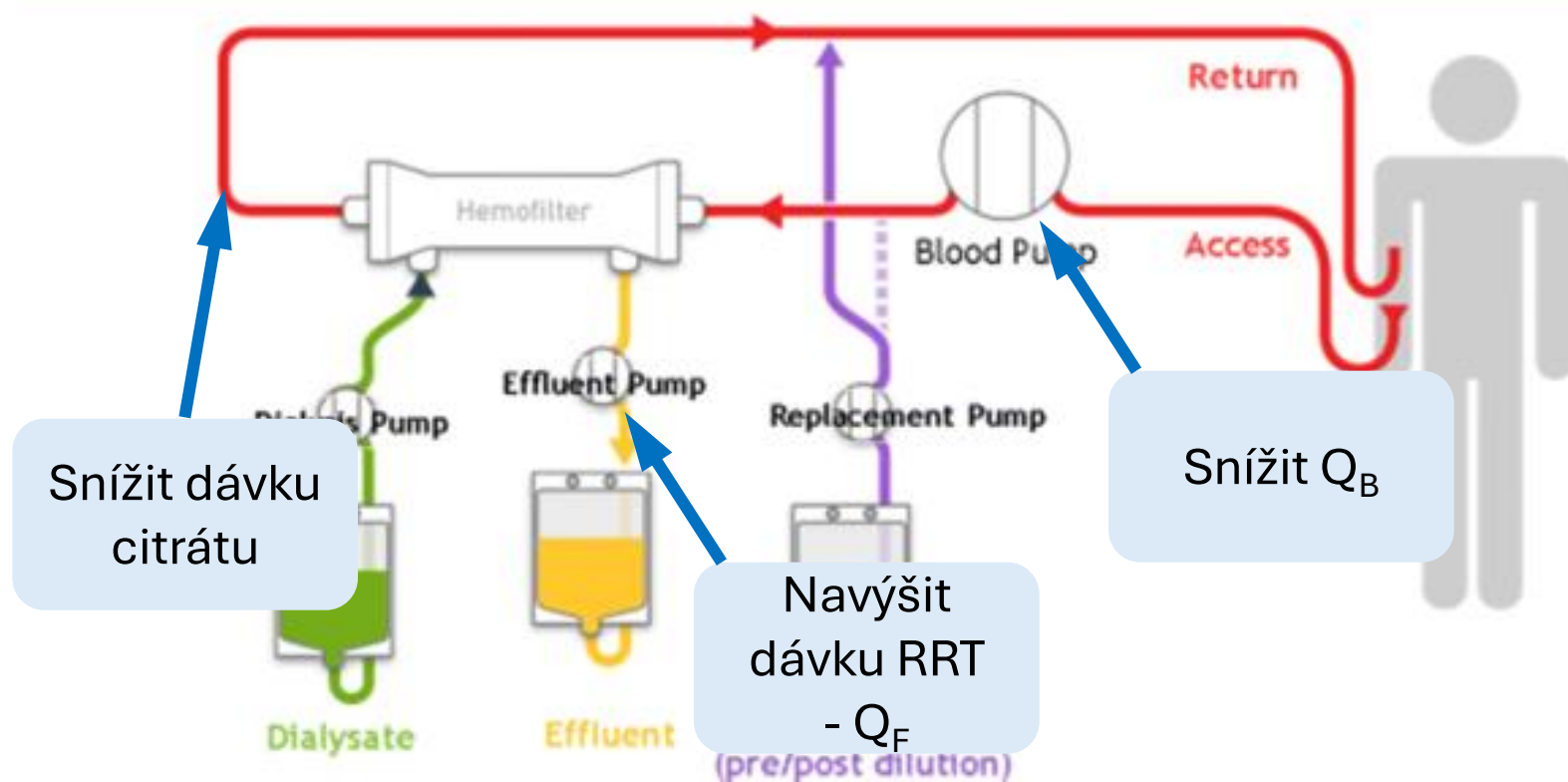
Continuous VenoVenous HemoDiaFiltration (CVVHDF)



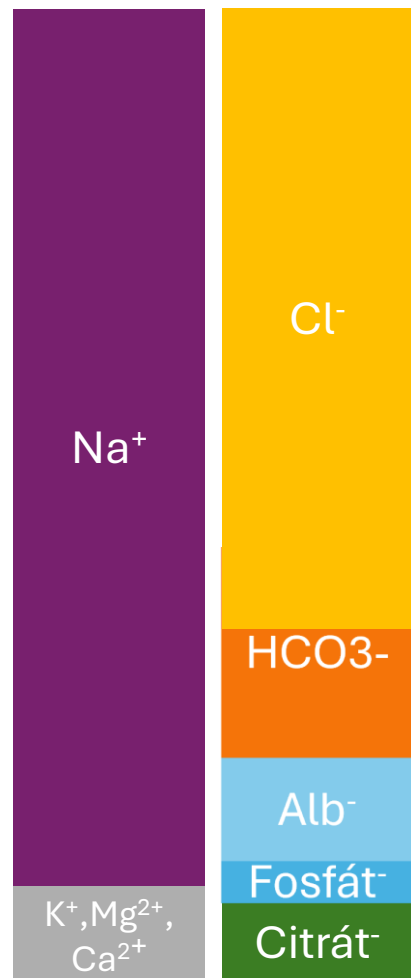
MAL z přetížení citrátem



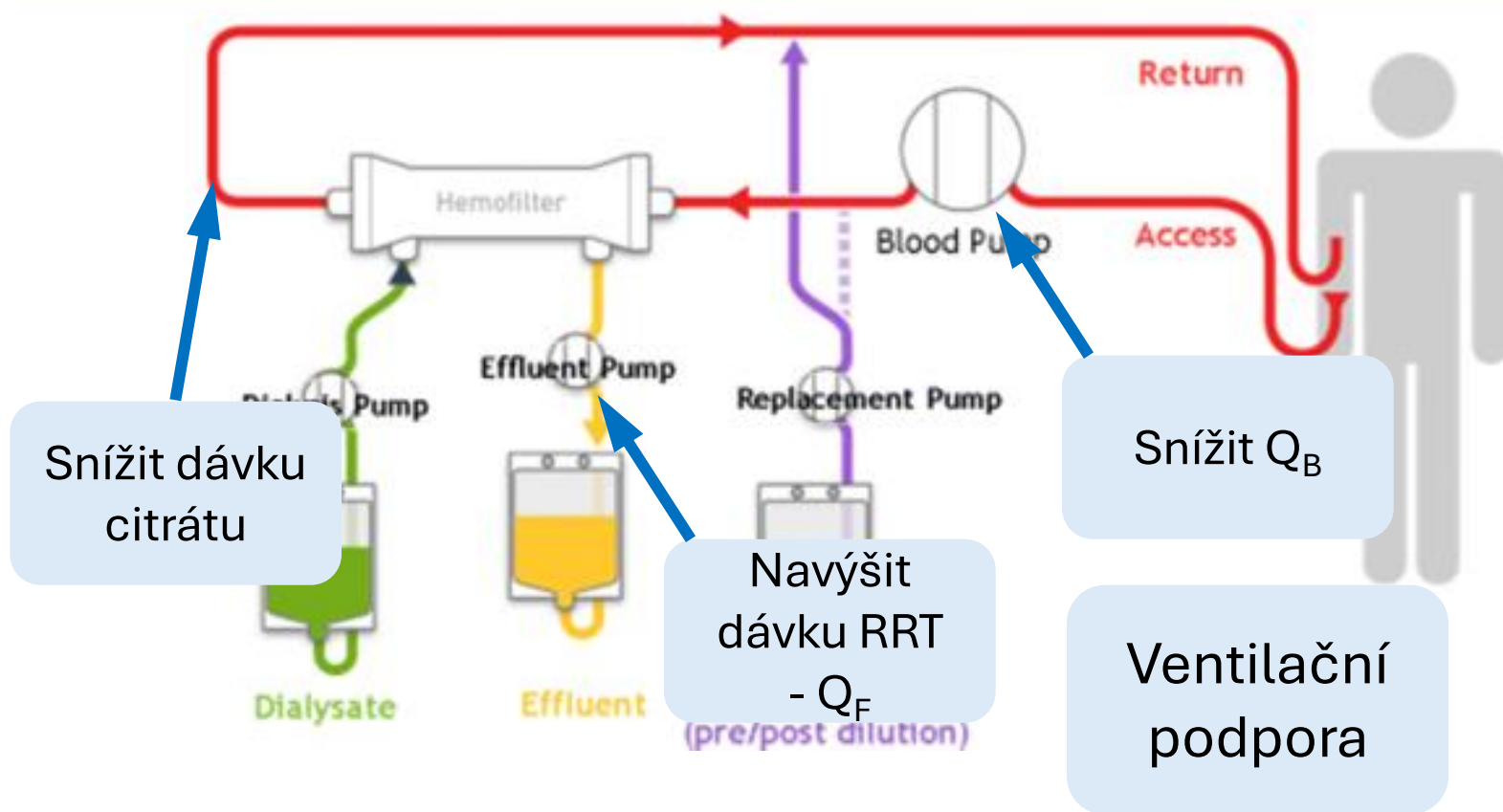
Continuous VenoVenous HemoDiaFiltration (CVVHDF)



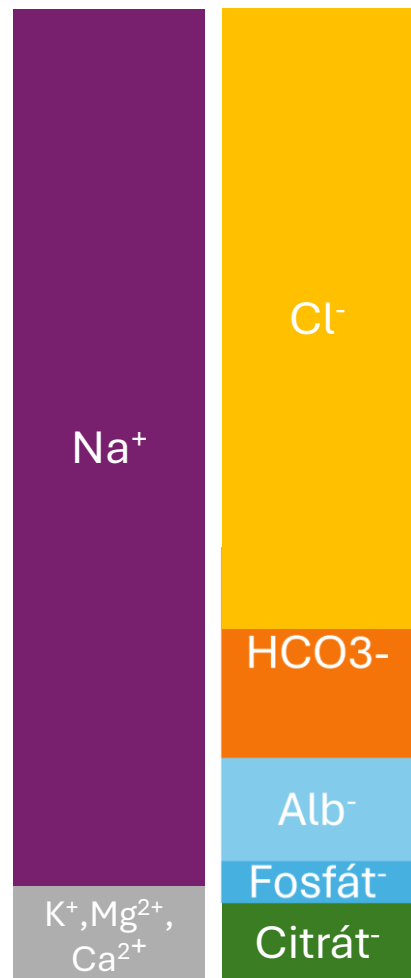
Respirační acidóza



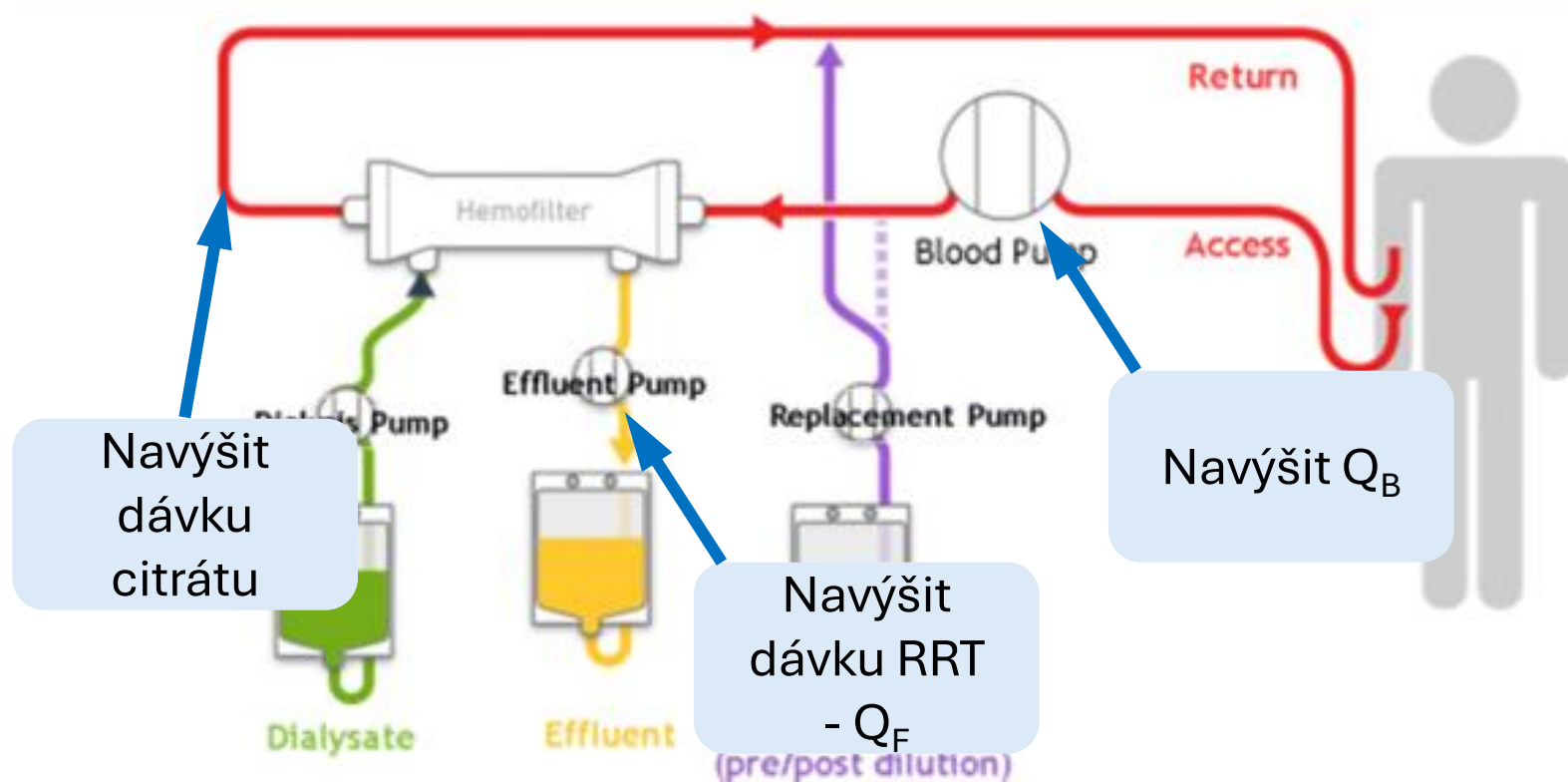
Continuous VenoVenous HemoDiaFiltration (CVVHDF)



MAC z se sníženým SID



Continuous VenoVenous HemoDiaFiltration (CVVHDF)



Děkuji za pozornost