

Gradual reaction first pathway sequences start with water $12\text{H}_2\text{O}$ flux from root to stomata cell membrane surface through aquaporin channels. Reaction in stomata forms pure $\text{CO}_{2\text{aqua}}$ 30,52 les AIR $\text{CO}_2\uparrow\text{gas}$ 300 ppm in endoergic $\Delta G_r = 8,474 \text{ kJ/mol}$ and $\Delta H_r = -20,1986 \text{ kJ/mol}$ exothermic equilibrium moisture carbon dioxide:

I) $\text{CO}_2\uparrow\text{gas} + \Delta G_{\text{aqua}} \rightleftharpoons \text{Q} + \text{CO}_{2\text{aqua}}$; $K_{\text{eq}} = [\text{CO}_{2\text{aqua}}]/[\text{CO}_2\uparrow\text{gas}] = 10^{-1.4846} = 1 / 30,52$: Normal concentration sum page 5 $[\text{CO}_{2\text{aqua}} + \text{HCO}_3^-] = 0,023 \text{ M} / 55,3 \text{ M} = X = 0,0004159$ mol fraction; $X_{\text{AIR}} = 300/10^6 = 0,0003$; $X/X_{\text{gaiss}} = 1,3864$ ratio, as $\Delta G_{\text{aqua}} = \Delta G^\circ_{\text{aqua}} + R \cdot T \cdot \ln(K_{\text{eq}}) = 8,47 + 8,3144 \cdot 298,15 \cdot \ln(10^{-1.485}) = 0$ at equilibrium zero value.

Carbonic Anhydrase CA $\text{H}_2\text{O} \xrightarrow{\text{CA}} \text{CO}_2/\text{H}_3\text{O}^+ + \text{HCO}_3^-$ improve assimilation 30,52+11,79 times additional with water produce proton and bicarbonate concentration gradient driving exoergic through membrane crossing channels HCO_3^- and H^+ : $2\text{H}_2\text{O} + \text{CO}_2\uparrow\text{gas} \rightleftharpoons \text{CO}_{2\text{aqua}} + 2\text{H}_2\text{O} + \text{Q} \xleftarrow{\text{CA}} \text{H}_3\text{O}^+ + \text{HCO}_3^- \xleftarrow{\text{Membrane Channels}} \text{H}_3\text{O}^+ + \text{HCO}_3^-$. exothermic $\Delta H = -20,1986 \text{ kJ/mol}$; endothermic $\Delta H = 9,7576 \text{ kJ/mol}$; athermic; $\Delta H = 0 \text{ kJ/mol}$;

total exothermic $\Delta H = -10,441 \text{ kJ/mol}$;
 endoergic $\Delta G = +8,474 \text{ kJ/mol}$; ; endoergic $\Delta G = +58,36 \text{ kJ/mol}$; exoergic $\Delta G_r = -10,618 - 4,055 = -14,7 \text{ kJ/mol}$;
 $\Delta G_{\text{HCO}_3} = RT \ln([\text{HCO}_3^-]_{\text{right}}/[\text{HCO}_3^-]_{\text{left}}) = 8,3144 \cdot 298,15 \cdot \ln(0,003/0,0154) = -4,0549 \text{ kJ/mol} \dots\dots$
 $\Delta G_{\text{H}} = RT \ln([\text{H}_3\text{O}^+]_{\text{right}}/[\text{H}_3\text{O}^+]_{\text{left}}) = 8,3144 \cdot 298,15 \cdot \ln(10^{-7,36}/10^{-5,5}) = -10,61682 \text{ kJ/mol} \dots\dots\dots$

First pathway finish at ENZYME complex Photo Synthetic Reaction Center (PRC) of green plants.

Photosynthesis in thylakoid cell reach exothermic $\Delta H = 6 \cdot -10,441 \text{ kJ/mol}$ six plus six $6\text{H}_3\text{O}^+ + 6\text{HCO}_3^-$ components.

Second pathway II) start with 1) (PRC) Photo Synthetic Reaction Center ENZYME complex of green plants products. Photosynthetic Reaction Center engine is red and blue light photons absorbed energy accumulate in glucose $\text{C}_6\text{H}_{12}\text{O}_6$ and oxygen $6\text{O}_{2\text{aqua}}$ endothermic $\Delta H = +2805,27 \text{ kJ/mol}$ and $\Delta G = 3049.55 \text{ kJ/mol}$ endoergic. Sun radiation, is consumed also the heat energy to shift evaporation endothermic processes of oxygen 6O_2 and water $6\text{H}_2\text{O}$ out of green plant stomata open hole. So substrates oxygen 6O_2 and water $6\text{H}_2\text{O}$

1) $C_{\text{osm}} = 1 \text{ C}_6\text{H}_{12}\text{O}_6$ increase osmotic pressure outside cell 12 times as osmolar: $C_{\text{osm}} = 6 + 6 = 12$ concentration in cell from init $C_{\text{osm}} = 6 + 6 = 12$ decreases to one glucose $\text{C}_6\text{H}_{12}\text{O}_6$ molecule $C_{\text{osm}} = 1$ and flow intensity through aquaporins increases out of green plant cells. Osmotic pressure is proportional to osmolar concentration $C_{\text{osm}} = 12 \text{ M}$ twelve times higher pressure $\pi = C_{\text{osm}} \cdot R \cdot T$ (kPa).

(PRC) $6\text{HCO}_3^- + 6\text{H}_3\text{O}^+ + \text{Q} \xrightleftharpoons[\text{BioEnergetic}]{\text{light red blue photo synthesis } E=h\nu \text{ PRC}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_{2\text{aqua}} + 6\text{H}_2\text{O}$

6O_2 and water $6\text{H}_2\text{O}$ pushed out of cells with twelve times higher pressure as concentration gradient through:

2) aquaporins $\text{H}_2\text{O} + \text{O}_{2\text{aqua}} \xleftarrow{\text{Aquaporins}} \text{O}_{2\text{aqua}} + \text{H}_2\text{O}$ $\Delta G = -6,41 \text{ kJ/mol}$ exoergic and athermic $\Delta H = 0 \text{ kJ/mol}$:
 $\Delta G_{\text{channel}} = RT \ln([\text{O}_{2\text{aqua}}]_{\text{right}}/[\text{O}_{2\text{aqua}}]_{\text{left}}) = 8,3144 \cdot 298,15 \cdot \ln(1/12) = -6.41 \text{ kJ/mol}$; $12 \cdot -6.41 = -76,96 \text{ kJ/mol}$ for 6O_2

3) Finally exoergic $\Delta G = -7,76 \text{ kJ/mol}$ and endothermic $\Delta H = 55,3 \text{ kJ/mol}$ to form in AIR $\text{O}_{2\text{AIR}}$ as evaporation



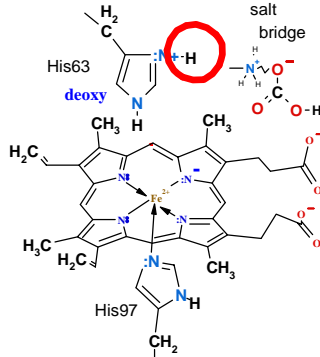
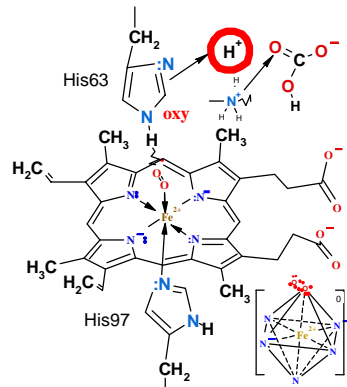
Plants need supply energy as heat to support evolved and evaporated substrates products oxygen $\text{O}_{2\text{AIR}}\uparrow$ as well water $\text{H}_2\text{O}_{\text{AIR}}\uparrow$ vapor through stomata open hole. According Le Chatelier principle heat as energy supply shift endothermic equilibrium evaporation of $\text{O}_{2\text{AIR}}\uparrow$ and $\text{H}_2\text{O}\uparrow$ outside \rightarrow through green plant stomata open hole. Opening the stomata holes depends on environment temperature and humidity. Evaporation velocity increases at higher temperature as heat supply if at enough water supply usually from roots. Closing of stomata holes decreases the evaporation velocity in plants, so to prevent drying the organism as loose the water in evaporation.

Similar human **O₂ OSMOSIS** and oxidative assimilation with produced **CO₂** gas in to **AIR** mechanism

Gradual reaction sequences start with osmosis through membrane aquaporin channels inside stomata holes.

I) Oxygens O₂aq_{ua} from AIR 20.95% **O₂** dissolution in water by osmosis through aquaporins entrance in organism: $\Delta H = -11,7 \text{ kJ/mol}$ exothermic $\text{O}_{2\text{AIR}} + \text{H}_2\text{O} \xleftarrow{\text{Aquaporin}} \text{H}_2\text{O} + \text{O}_{2\text{aq_{ua}}} + Q$ $\Delta G = 16,36 \text{ kJ/mol}$ endoergic. $C_{\text{osm}} = 0,305$ and alveolar $C = 0.2 \text{ M}$ $\Delta G_{\text{H}_2\text{O}} = RT \ln([\text{H}_2\text{O}]_{\text{right}}/[\text{H}_2\text{O}]_{\text{left}}) = -8,3144 * 298,15 * \ln(0,305/0,2) = -1.046 \text{ kJ/mol}$ exoergic.

Plant **deoxy** Leghemoglobin **LHb_T** from water medium adsorb inspired fresh AIR **O₂aq_{ua}** releases proton **H⁺**: **oxyLHb_R**(His63O₂) + **H⁺** $\leftarrow [\text{O}_2] = 1,85 \cdot 10^{-5} \text{ M}$ \rightarrow **deoxy(H⁺His63)LHb_T** + **O₂aq_{ua}**; In water soluted oxygen **[O₂aq_{ua}]** = $9,768 \cdot 10^{-5} \text{ M}$ concentration and normal cytosolic concentration reaches value **[O₂]** = $1,85 \cdot 10^{-5} \text{ M}$.



Concentration gradient across membrane $\Delta G_{\text{O}_2} = RT \ln([\text{O}_2]_{\text{right}}/[\text{O}_2]_{\text{left}}) = -8,3144 * 298,15 * \ln(1,85/9,768) = -4.12 \text{ kJ/mol}$.

Sum $\Delta G = 16,36 - 1.046 - 4.12 = 11,2 \text{ kJ/mol}$, $\Delta H = -11,7 \text{ kJ/mol}$.

Second **II)** pathway begins with carbonic anhydrase **AC** equilibrium shifted to right by oxidative phosphorylation increase product **CO₂aq_{ua}** and capturing protons **H⁺** **deoxy(H⁺His63)LHb_T** stabilizes **pH=7,36** concentration **H₃O⁺** as instead **CA** made new.

II) Q_{aq_{ua}} + **CO₂aq_{ua}** + **2H₂O** $\xleftarrow{\text{CA}}$ **H₃O⁺** + **HCO₃⁻** $\xleftarrow{\text{Membrane}}$ **H₃O⁺** + **HCO₃⁻** \leftrightarrow **H₂O** + **H₂CO₃** + **Q_{gas}** \leftrightarrow **H₂O** + **CO₂↑_{gas}** + **H₂O** endothermic $\Delta H_r = +9,76 \text{ kJ/mol}$; athermic $\Delta H_r = 0 \text{ J/mol}$ exothermic $\Delta H_r = -9.76 \text{ kJ/mol}$; endothermic $\Delta H_r = +20,29 \text{ kJ/mol}$;

gradient $\Delta G_{\text{HCO}_3^-} = -RT \ln([\text{HCO}_3^-]_{\text{right}}/[\text{HCO}_3^-]_{\text{left}}) = -8,3144 * 298,15 * \ln((0,0154/0,0338919)) = -1,9554 \text{ kJ/mol}$.

gradient $\Delta G_{\text{H}_3\text{O}^+} = -RT \ln([\text{H}_3\text{O}^+]_{\text{right}}/[\text{H}_3\text{O}^+]_{\text{left}}) = -8,3144 * 298,15 * \ln((10^{-5.5}/0,02754)) = -22,49 \text{ kJ/mol}$.

Sum $\Delta G_r = \Delta G_{\text{HCO}_3^-} + \Delta G_{\text{H}_3\text{O}^+} = -1,9554 + -22,49 = -24,44 \text{ kJ/mol}$

endoergic $\Delta G_r = +58.36 \text{ kJ/mol}$; exoergic $\Delta G_r = -22,44 \text{ kJ/mol}$; exoergic $\Delta G_r = -58.205 \text{ kJ/mol}$; exoergic $\Delta G_r = -8,538912 \text{ kJ/mol}$.

Total sum in sequence **endothermic** $\Delta H_r = +9,5876 + 0 - 9,76 + 20,291 = +20,1 \text{ kJ/mol}$ and free energy change

exoergic $\Delta G_r = +58,36 - 22,44 - 58,205 - 8,538912 = -30,82 \text{ kJ/mol}$ spontaneous total sum in sequence.

The ENZYME carbonic anhydrase (CA) from **CO₂aq_{ua}** make acid/base equilibrium:

CO₂aq_{ua} + **2H₂O** $\xleftarrow{\text{CA}}$ **H₃O⁺** + **HCO₃⁻** value $K = [\text{H}_3\text{O}^+] \cdot [\text{HCO}_3^-] / [\text{CO}_{2\text{aq_{ua}}}] / [\text{H}_2\text{O}]^2 = 2,901 \cdot 10^{-11}$ is constant but water constant concentration **[H₂O]** = 55.3 M is included in $K_{\text{eq}} = K \cdot [\text{H}_2\text{O}]^2 = [\text{H}_3\text{O}^+] \cdot [\text{HCO}_3^-] / [\text{CO}_{2\text{aq_{ua}}}] = 10^{-7.0512}$ equilibrium constant value and its exponent is $\text{p}K_{\text{eq}} = -\log(K_{\text{eq}}) = 7.0512$. Weak acid **CO₂aq_{ua}** and its salt is ubiquities buffer system in living organism. It's reveals the Attractor of oxidative phosphorylation final product **CO₂aq_{ua}** for **HOMEOSTASIS 7,36 = pH = pK + log([HCO₃⁻]/[CO₂aq_{ua}]) = 7.0512 + log(2.0263/1)** reach the value **pH=7.36±0.01** according Henderson Haselbalh equation with alkaline reserve 2.0263.

CA equilibrium endothermic $\Delta H_r = +9.59 \text{ kJ/mol}$ and endoergic $\Delta G_r = +58.19 \text{ kJ/mol}$ compensate exothermic and exoergic oxidative phosphorylation, beta oxidation reactions produced energy is used for shifting **II)** pathway equilibriums to right for reaching **stomata** spongy mesophyll cell surface to evaporate carbon dioxide **CO₂↑_{gas}**.

Through bicarbonate **HCO₃⁻** and proton **H⁺** channels crossing membranes transport ENZYMES in athermic $\Delta H = 0 \text{ kJ/mol}$ and exoergic $\Delta G = -0,245 \text{ kJ/mol}$ processes form carbonic acid **H₂CO₃** molecules as ENZYME Carbonic Anhydrase **CA** is absent: **H₃O⁺** + **HCO₃⁻** $\xleftarrow{\text{Membrane}}$ **H₂O** + **H₂CO₃** + **Q**.

In **stomata** spongy mesophyll cell surface (out side organism) with absence **CA** decomposes carbonic acid **H₂CO₃** to gas **CO₂↑_{gas}** in endothermic $\Delta H_r = +20.29 \text{ kJ/mol}$ and in exoergic $\Delta G_r = -8,54 \text{ kJ/mol}$ reaction as **pH=5,5**:

H₂CO₃ + **Q** \rightarrow **H₂O** + **CO₂↑_{gas}**. Heat supply shifts equilibrium right side \rightarrow according Le Chatelier's principle. Plants have the **stomata** spongy mesophyll cell surface located inside stomata and equipped with heat accumulating cells in leaves faced to sun shine as heating promote breath out **CO₂↑_{gas}**, so keeping constant **pH=7.36±0.01** in organism. If climate temperature warm so more intensive exchange of gases in nature.

Each adsorbed oxygen **O₂aq_{ua}** on Leghemoglobin releases proton **H⁺** which increases acidity on **stomata** spongy mesophyll cell surface. The **stomata** spongy mesophyll cell surface has the specific building: super thin 0.6 nm **water** layer $S = 950 \text{ nm} \times 950 \text{ nm} = 0.9 \mu\text{m}^2$ as square within $0.5415 \cdot 10^{-3} \mu\text{m}^3 = 0.5415 \cdot 10^{-18} \text{ L}$ small volume. Created acidity in thin **water** layer volume increases up to **pH=5.5** if one proton **H⁺** crosses the membrane channel reaching the surface and that cause fast decomposition of carbonic acid **H₂CO₃** to evolving **CO₂↑_{gas}** maintaining high concentration which support the photosynthesis gradual sequence shifting to production of glucose **C₆H₁₂O₆** and oxygen **O₂**. Additionally epithelial cell surface **pH=5.5** has anti-bacterial as well as anti-septic properties to prevent infection in organism. Carbonized mineral water has anti-bacterial as well as anti-septic properties.

Similar human O_2 , CO_2 metabolism, Carbonic Anhydrase, Shuttle deoxy-oxy LegHEMOGLOBIN Brønsted Acid/Base CA and hemoglobin shuttle enzymes of O_2 , $CO_{2(aqua)} / HCO_3^- + H^+$

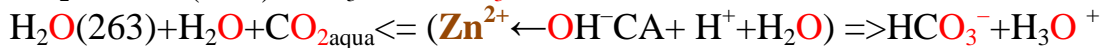
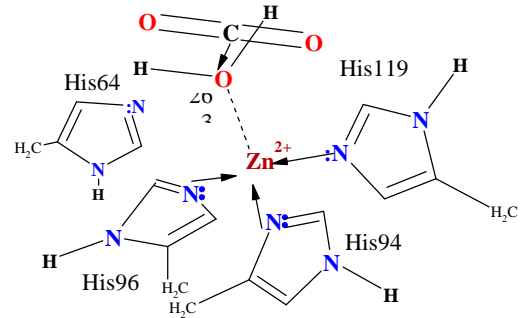
Enzyme Carbonic anhydrase (CA) made acid/base equilibrium $H_2O-CA-CO_2/HCO_3^- + H_3O^+$

There are shuttle buffer systems, that act in the organism and allow pH of the organism to be stabilized constant in narrow interval ($pH = 7.36_{-0,01}^{+0,02}$) despite the fact, that organism

produces great amount of metabolic $[CO_{2(Krebs)}] = 0,0275$ M. The CA made amount of acidic products is $[H_3O^+] = [HCO_3^-] = 0,0275$ M compensated by buffer solution. CA are connected to shuttle Leghemoglobin captured proton H^+ by oxygen $O_{2(aqua)}$ desorption due to Krebs product $CO_{2(aqua)}$ target cells in tissues:

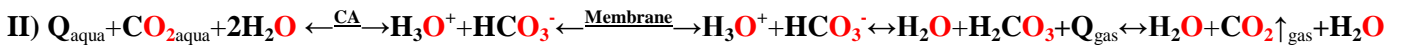
Hydrogen carbonate buffer system carbonic anhydrase equilibrium keeps weak acid $CO_{2(aqua)}$ and bicarbonate ions in human organism in amounts $[HCO_3^-] = 0.0154$ M, $[CO_{2(aqua)}] = 0.0076$ M, referring to 56,23 mL (50-60 mL) released volume CO_2 from 100 mL blood as alkaline reserve 2,036 / 1 in clinic evaluation.

Carbon dioxide forms by oxidation of carbohydrates, of fats and of proteins. Bicarbonate is created as product in hydration $2H_2O$ of $CO_{2(aqua)}$ by CA enzyme Zn^{2+} ion active coordination center. It's location in enzyme carbonic anhydrase CA Zn^{2+} ion coordination pocket:



$H^+ + LHb_R(His63O_2) + HCO_3^- \rightleftharpoons O_{2(aqua)} + LHb(H^+His63) \dots$ salt bridge.. HCO_3^- stabilizing concentration $[O_2] = 6 \cdot 10^{-5}$ M.

Deoxy Leghemoglobin $LHb(H^+His63)$ capture proton H^+ at histidine residue and HCO_3^- forms deoxy $LHb_T(H^+His63) \dots$ salt bridge.. HCO_3^- (Tense state). In stomata shuttle absorbs oxygen in oxy Leghemoglobin $LHb_R(His63O_2)$ (Relax state) releasing proton H^+ and bicarbonate HCO_3^- .

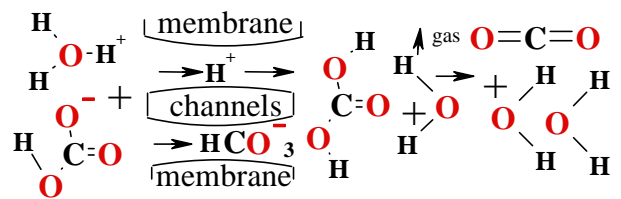
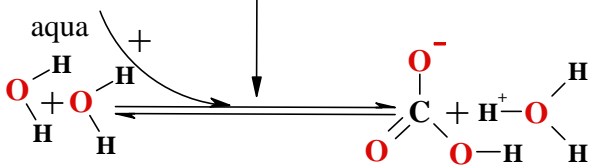


Metabolic $CO_{2(aqua)}$ exchanged per O_2 consuming by ENZYME Carbonic Anhydrase (CA) converts to HCO_3^- and H_3O^+ at stabilized $pH = 7.36 \pm 0,01$ with alkaline reserve $2.036/1 = [HCO_3^-]/[CO_2]$.

1) first reaction with ENZYME Carbonic Anhydrase (CA) converts metabolic $CO_{2(aqua)}$ to bicarbonate anion. The oxidation product $CO_{2(aqua)}$, $2H_2O$ concentration $pH = 7,36$ drive of endothermic and endoergic reaction:

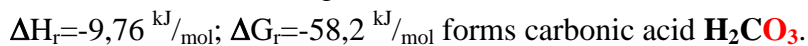


$O=C=O$ carbonic anhydrase



2) Second process athermic $\Delta H = 0 \text{ kJ/mol}$ $H_3O^+ + HCO_3^- \xleftarrow{Membrane} H_3O^+ + HCO_3^- + \Delta G$; $\Delta G = -24,44 \text{ kJ/mol}$ exoergic concentration gradients $\Delta G_{HCO_3^-} = RT \ln([HCO_3^-]_{right}/[HCO_3^-]_{left}) = RT \ln((0,0154/0,0338919)) = -1,9554 \text{ kJ/mol}$; and $\Delta G_H = RT \ln([H_3O^+]_{right}/[H_3O^+]_{left}) = RT \ln((10^{-5,5})/0,02754) = -22,49 \text{ kJ/mol}$ where $R = 8,3144$, $T = 298$ K. Transport ENZYMES catalyzes bicarbonate HCO_3^- and proton H^+ move through channels crossing membranes.

3) Third gradual exothermic and exoergic reaction $H^+ + HCO_3^- \rightarrow H_2CO_3 + Q$;



4) Fourth gradual reaction on stomata spongy mesophyll cell surface (out side organism) decomposes carbonic acid H_2CO_3 to gas $CO_2 \uparrow_{gas}$ in endothermic: $H_2CO_3 + Q(gas) \rightarrow H_2O + CO_2 \uparrow_{gas}$ reaction $\Delta H_r = +20,291 \text{ kJ/mol}$; as well as exoergic reaction $\Delta G_r = -8,539 \text{ kJ/mol}$. Total endothermic $\Delta H = 20,1 \text{ kJ/mol}$; exoergic $\Delta G = -32,819 \text{ kJ/mol}$;

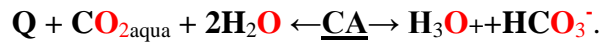
Each adsorbed oxygen $O_{2(aqua)}$ on LegHemoglobin releases proton H^+ which increases acidity on stomata spongy mesophyll cell surface. Surface has the specific building: super thin 0.6 nm water layer $S = 0.9 \mu m^2$ on $S = 950 \text{ nm} \times 950 \text{ nm}$ surface as square within small volume $0.5415 \cdot 10^{-3} \mu m^3 = 0.5415 \cdot 10^{-18} \text{ L}$ created acidity increases up to $pH = 5.5$ if one proton crosses the membrane channel reaching the surface and that cause fast decomposition of carbonic acid H_2CO_3 to evolving $CO_2 \uparrow_{gas}$ evaporate out.

Oxygen [$O_{2\text{aqua}}$]= $6 \cdot 10^{-5}$ M in *mitochondria* consumed for oxidation. $O_{2\text{aqua}}$ reactivity cause desorbition O_2 :

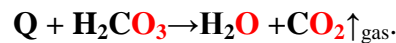


Oxygen through aquaporins crosses membrane into mitochondria. Concentration decreases below [$O_{2\text{aqua}}$]= $6 \cdot 10^{-5}$ M. Each desorbed oxygen adsorbs one proton to distal histidine H^{His63} in LegHemoglobin (H^{His63}) LHb_T and bind with salt bridge HCO_3^- so decreases produced metabolic product $CO_{2\text{aqua}}$ acidity effect keeping pH=7.36 constant.

2) $CO_{2\text{aqua}}$, which is a product of metabolism comes from *mitochondria* reacts with water, forming **carbonic anhydrase** made **endothermic** equilibrium:



ENZYME Carbonic Anhydrase (CA) equilibrium shifts to right by heat supply, high water [H_2O] concentration 55.3 M, low hydroxonium ion concentration [H_3O^+]= $10^{-7.36}$ M and constant value $pK_a=7.0512$ of reaction towards bicarbonate anion according Le Chatelier's principal to prevent of carbonic dioxide accumulation. Carbonic acid constant $pK=6.11$ shifts to one fold more acidic. Creating hazard for bubbling:



ENZYME Carbonic Anhydrase (CA) absent as out side plant organism enclosed with cell membranes.

Plant Henderson Haselbalh pH equation Homeostasis

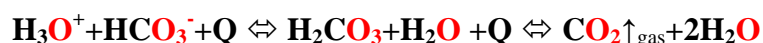
When these buffer systems struggle with acidic products $CO_{2\text{aqua}}$ of metabolism, more and more of the acid forms of the buffer systems are produced. For this reason, the acid forms have to be transported out of organism.

It is easy to imagine, that LegHemoglobin cannot be evolved out of organism, therefore there is only one buffer system, suitable for regulation of acid form's presence by breathing out $CO_2 \uparrow_{\text{gas}}$, that stabilize of plants **pH=7.36** by metabolic waste $CO_2 \uparrow_{\text{gas}}$ decreasing asidity problems for organism. Plant should be maintained attractor **7.36**. Carbo anhydrase absence reaction is negligible slow: $CO_{2\text{aqua}} + 2H_2O \text{ slow} \rightarrow H_3O^+ + HCO_3^-$ and shifts to fastest reversible carbonic acid formation reaction:



Reaction which provides accumulation of $CO_2 \uparrow_{\text{gas}}$ at pH=5,5 because carbonic acid $pK=6.11$ value is one fold more acidic as Carbonic Anhydrase CA $pK=7.0512$.

Carbonic anhydrase make conversion of $CO_{2\text{aqua}}$ to bicarbonate anion HCO_3^- in to **water** medium fast and establish acid-base $Q + CO_{2\text{aqua}} + 2H_2O \xleftarrow{CA} H_3O^+ + HCO_3^-$ **endothermic** equilibrium as producing right side reaction products $H_3O^+ + HCO_3^- - Q$ **endothermic** demanding to heat supply. So sun radiation Heating $+Q$, H^+ , HCO_3^- concentration as each $CO_{2\text{aqua}}$ form one H_3O^+ and HCO_3^- shifts equilibrium right side.



Carbonic anhydrase equilibrium constant $pK=7.0512$ decreases concentration acid form CO_2 into **water** H_2O (avoid carbonic acid H_2CO_3 formation which is one fold more acidic $pK=6.11$) therefore hydrogen carbonate HCO_3^- and hydrogen ions H^+ are involved into **pH** formation according buffer solution.

<i>Substance</i>	ΔH_r° , kJ/mol	ΔS_r° , J/mol/K	ΔG_r° , kJ/mol
H₃O⁺	-285.81	-3.854	-213,275
HCO₃⁻	-689.93	98.324	-586,94
H₂O	-285.85	69.9565	-237,191
CO₂↑_{gas}	-393.509	213.74	-394,359
CO₂_{aqua}	-413.7976	117.5704	-385,98
O₂↑_{gas}	0	205,04	0
O₂_{aqua}	-11.715	110.876	16,4
H₂CO₃	-699,65	187.00	-623,17