Carbon Cycle - Combustion, Metabolism

CH_4 + O_2 -> CO_2 + H_2O + energy

or oxygen carbon dioxide water (heat)

$C_6H_{12}O_6$

represents any fossil fuel, food, organic matter

Pathways for ATP Production

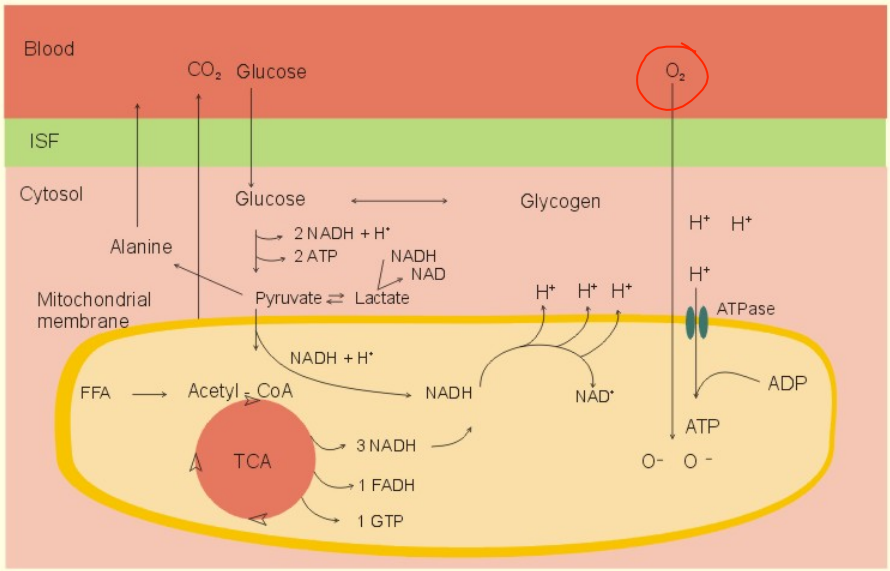
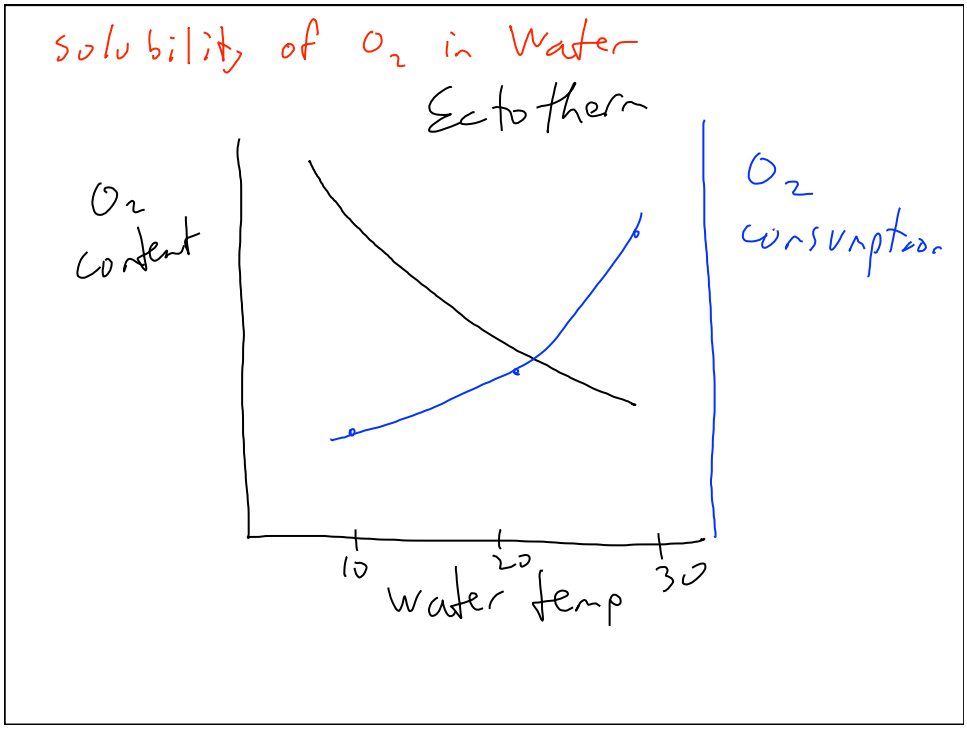
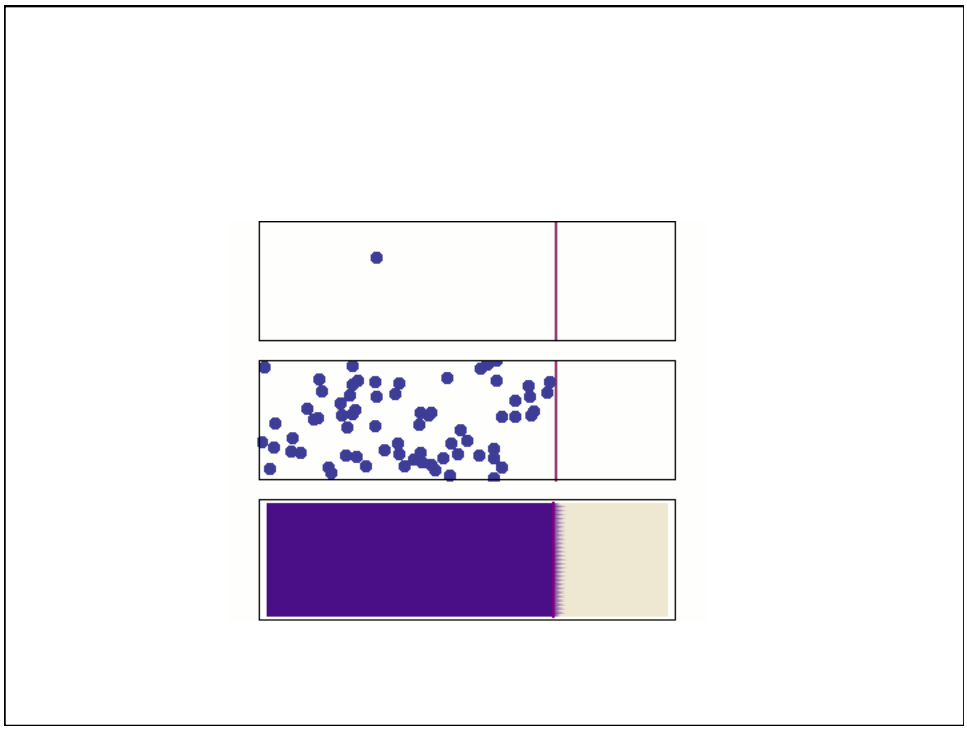
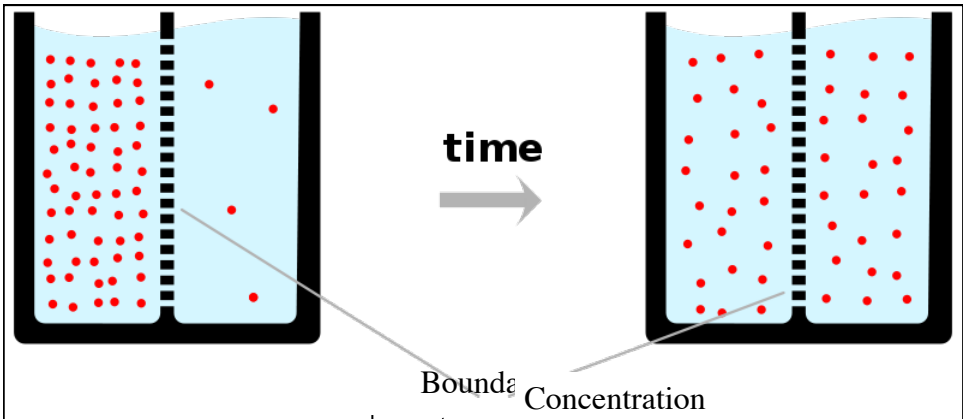


Fig. 20-2 http://www.zuniv.net/physiology/book/chapter20.html KMc


solubility of O_2 in Water
Ectotherm
O_2 content
O_2 consumption
10
20
30
water temp





Concentration
≈ Partial pressure

Rates of Diffusion

Fick's Law

$$Q = DA \frac{P_1 - P_2}{L}$$

Q = rate of diffusion
D = diffusion coefficient — substance, medium, temp
A = cross-sectional area
$P_1 - P_2$ = partial pressure difference
L = Path length through which diffusion occurs

What can an animal optimize?

D : Air is 200,000x faster than in H_2O

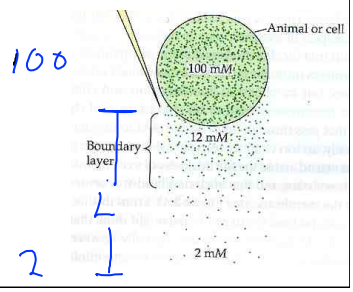
L : thin

A : maximize

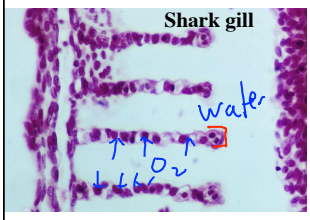
$P_1 - P_2$:

Reduce Boundary effects

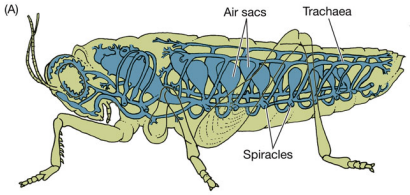
- ventilation
- use a sink



Gill surface area

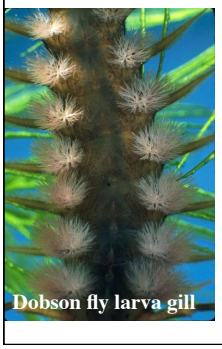


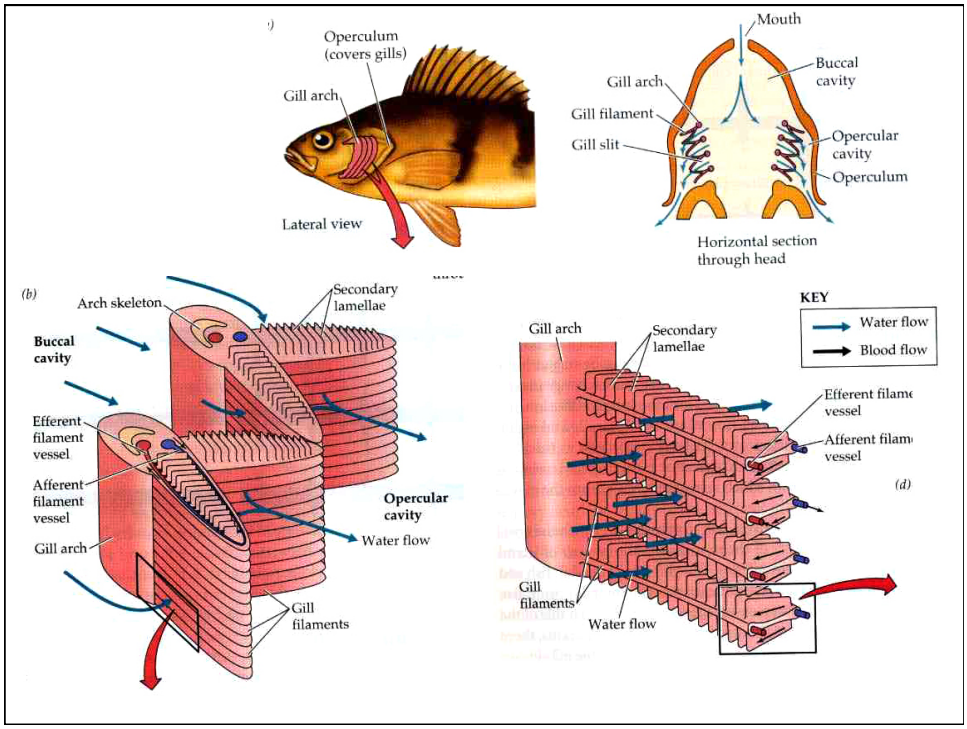
↑ area
↓ Length



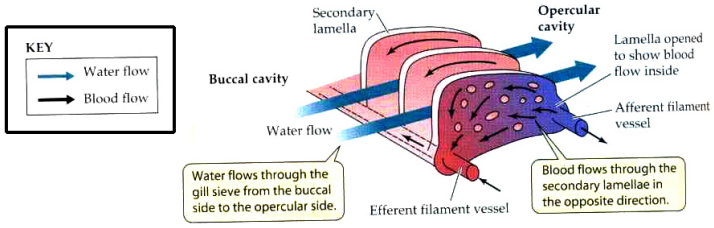
LIFE 8e, Figure 48.4 (Part 1)

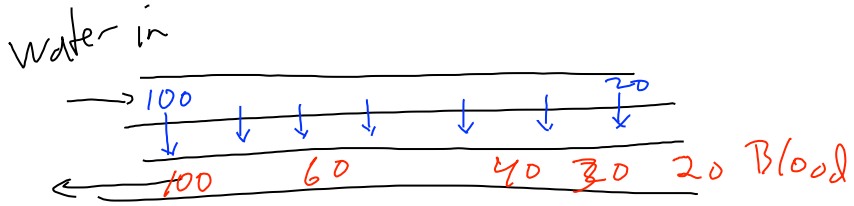
Gills invagination
lung invagination

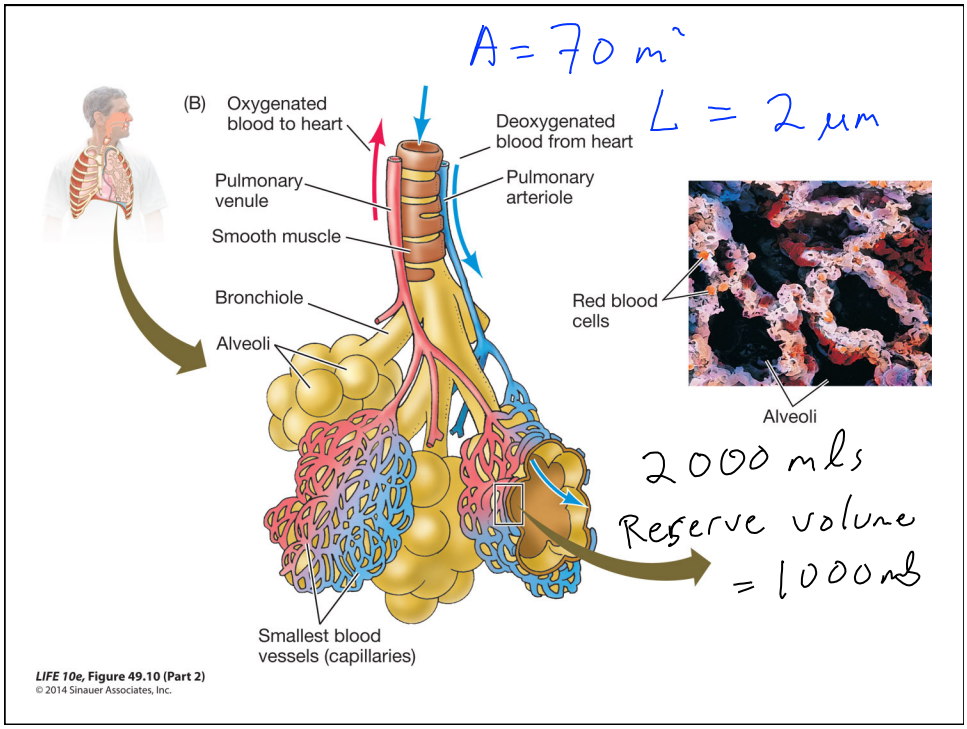




Countercurrent exchange






A = 70 m²
L = 2 μm
(B)
Oxygenated blood to heart
Deoxygenated blood from heart
Pulmonary venule
Pulmonary arteriole
Smooth muscle
Bronchiole
Alveoli
Red blood cells
Alveoli
2000 mls
Reserve volume = 1000 mls
Smallest blood vessels (capillaries)
LIFE 10e, Figure 49.10 (Part 2)
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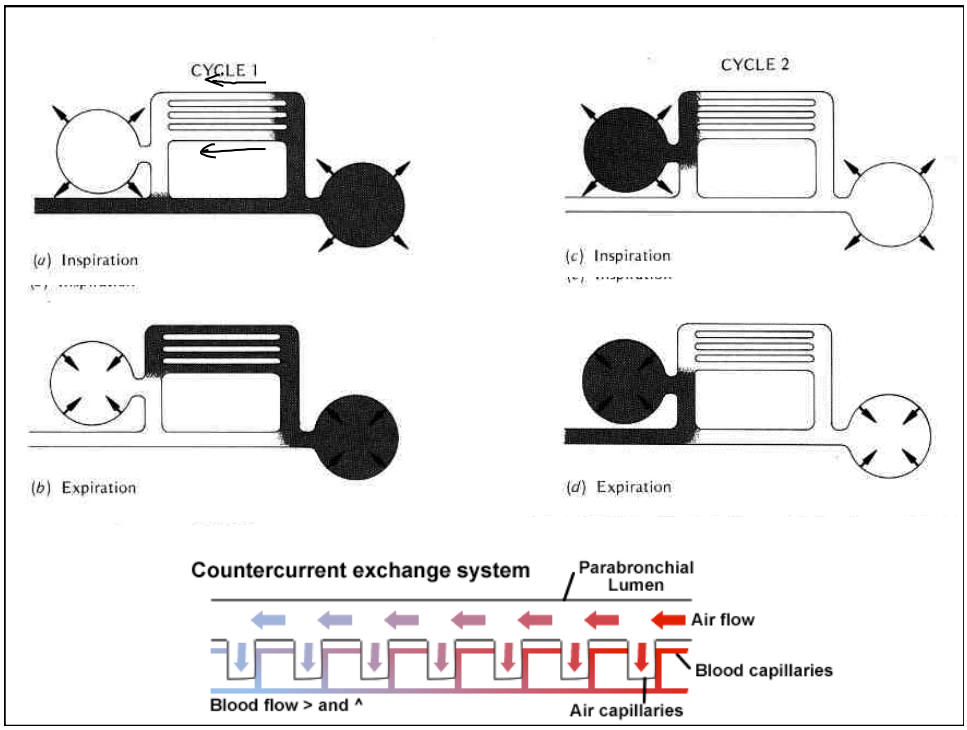
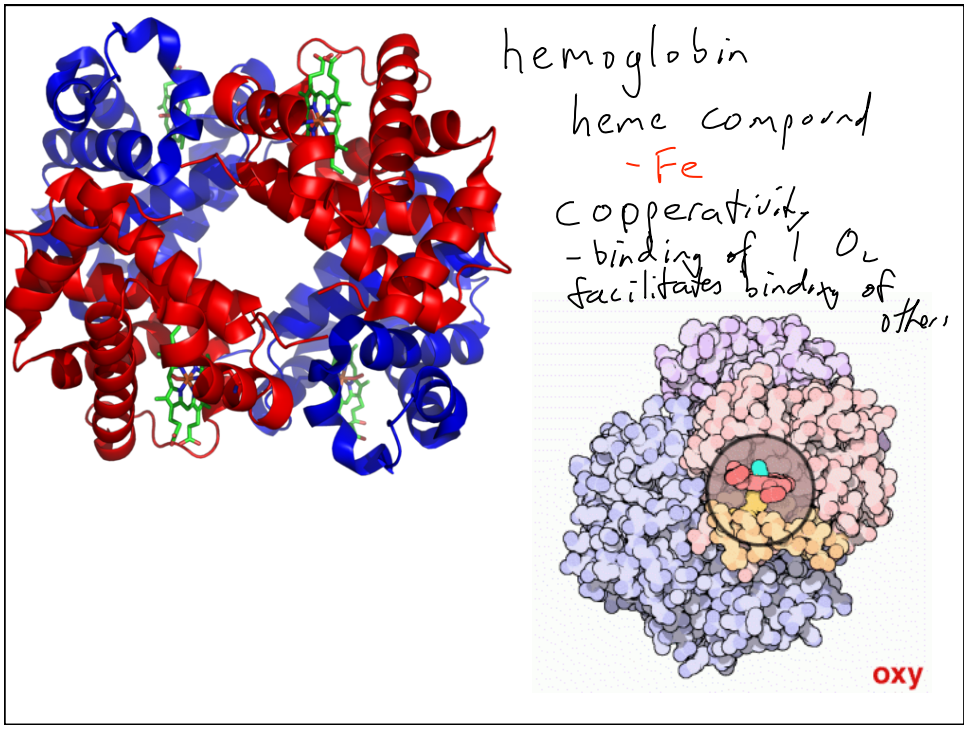
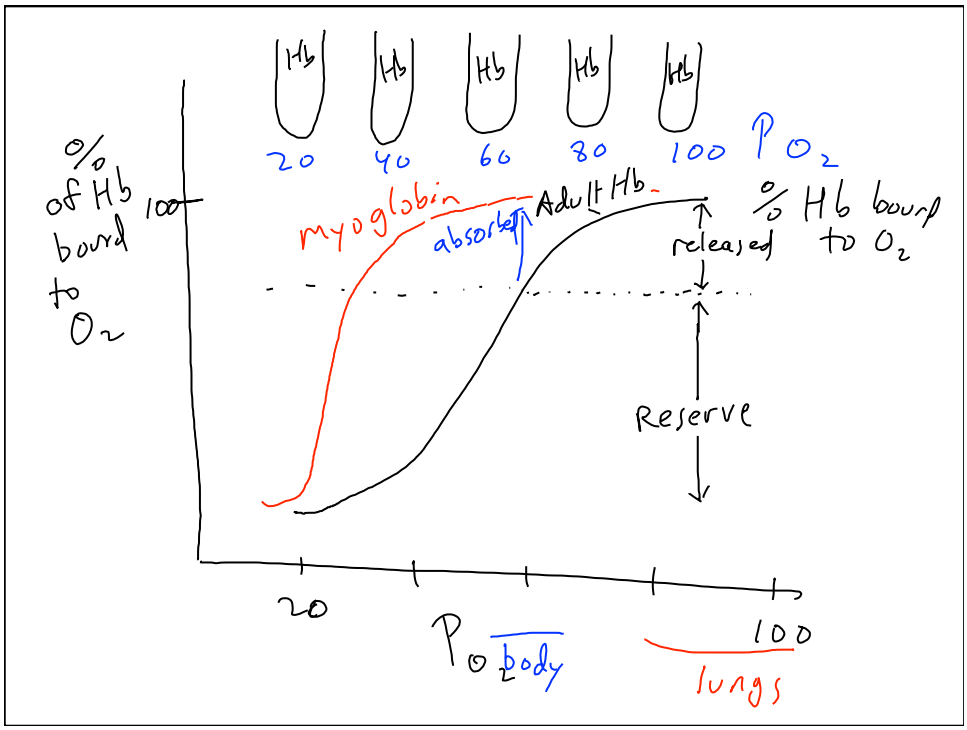
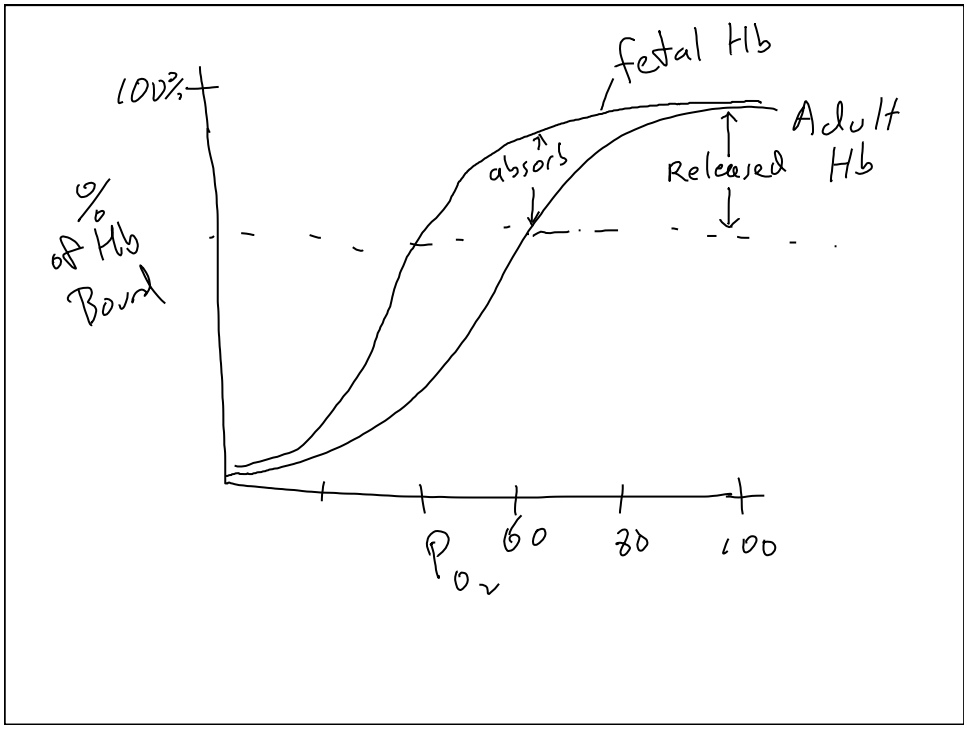
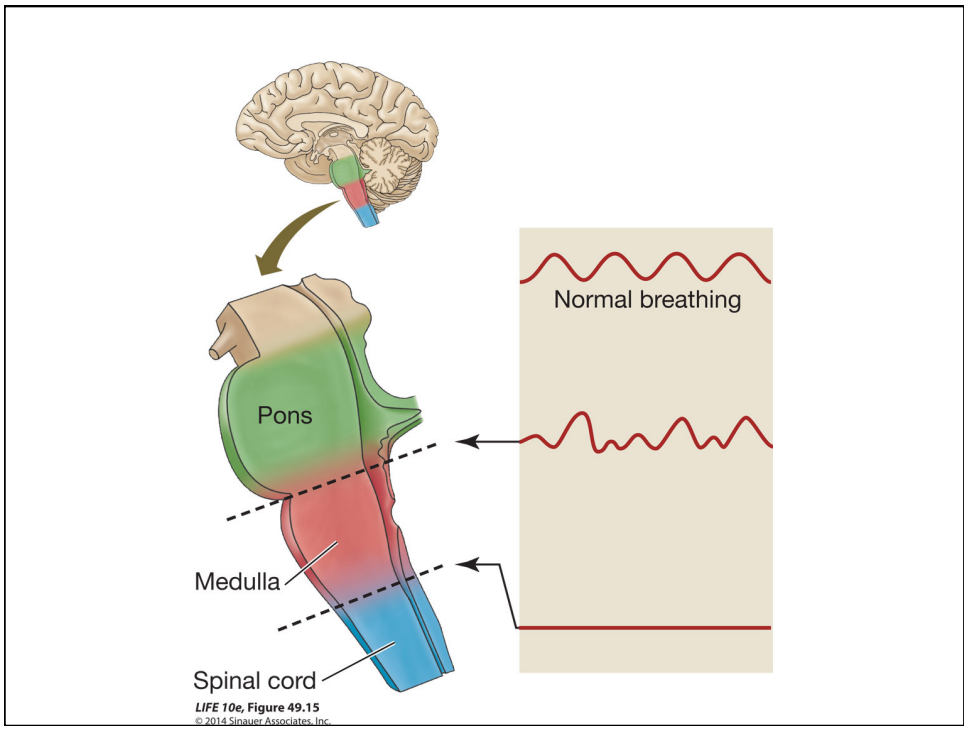

CYCLE 1
CYCLE 2
(a) Inspiration
(c) Inspiration
(b) Expiration
(d) Expiration
Countercurrent exchange system
Parabronchial Lumen
Air flow
Blood capillaries
Blood flow > and ^
Air capillaries


hemoglobin
heme compound
- Fe
copperativity
- binding of 1 O_2 facilitates binding of others
oxy


Hb
Hb
Hb
Hb
Hb
20
40
60
80
100
P_{O_2}
% of Hb bound to O_2
100
myoglobin
absorbed
Adult Hb
% Hb bound to O_2
released
Reserve
20
P_{O_2} body
100
lungs


fetal Hb
100%
Adult Hb
absors
Released
% of Hb Bound
60
80
100
P_{O_2}


Normal breathing
Pons
Medulla
Spinal cord
LIFE 10e, Figure 49.15
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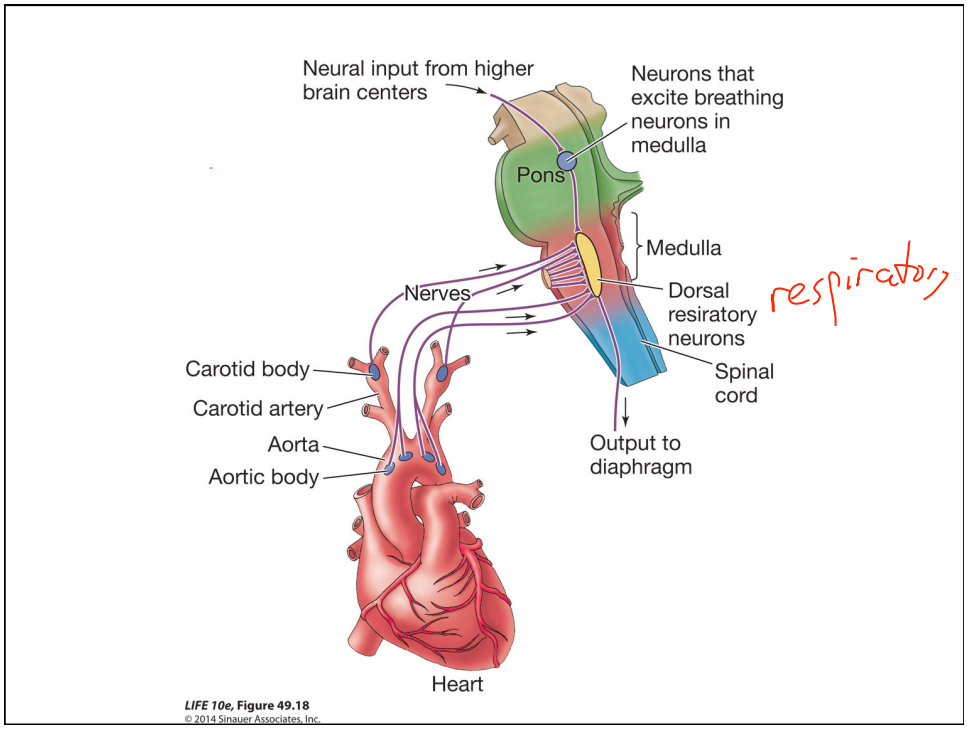
Neural input from higher brain centers
Neurons that excite breathing neurons in medulla
Pons
Medulla
Nerves
Dorsal resiratory neurons
respiratory
Spinal cord
Carotid body
Carotid artery
Aorta
Aortic body
Output to diaphragm
Heart
LIFE 10e, Figure 49.18
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