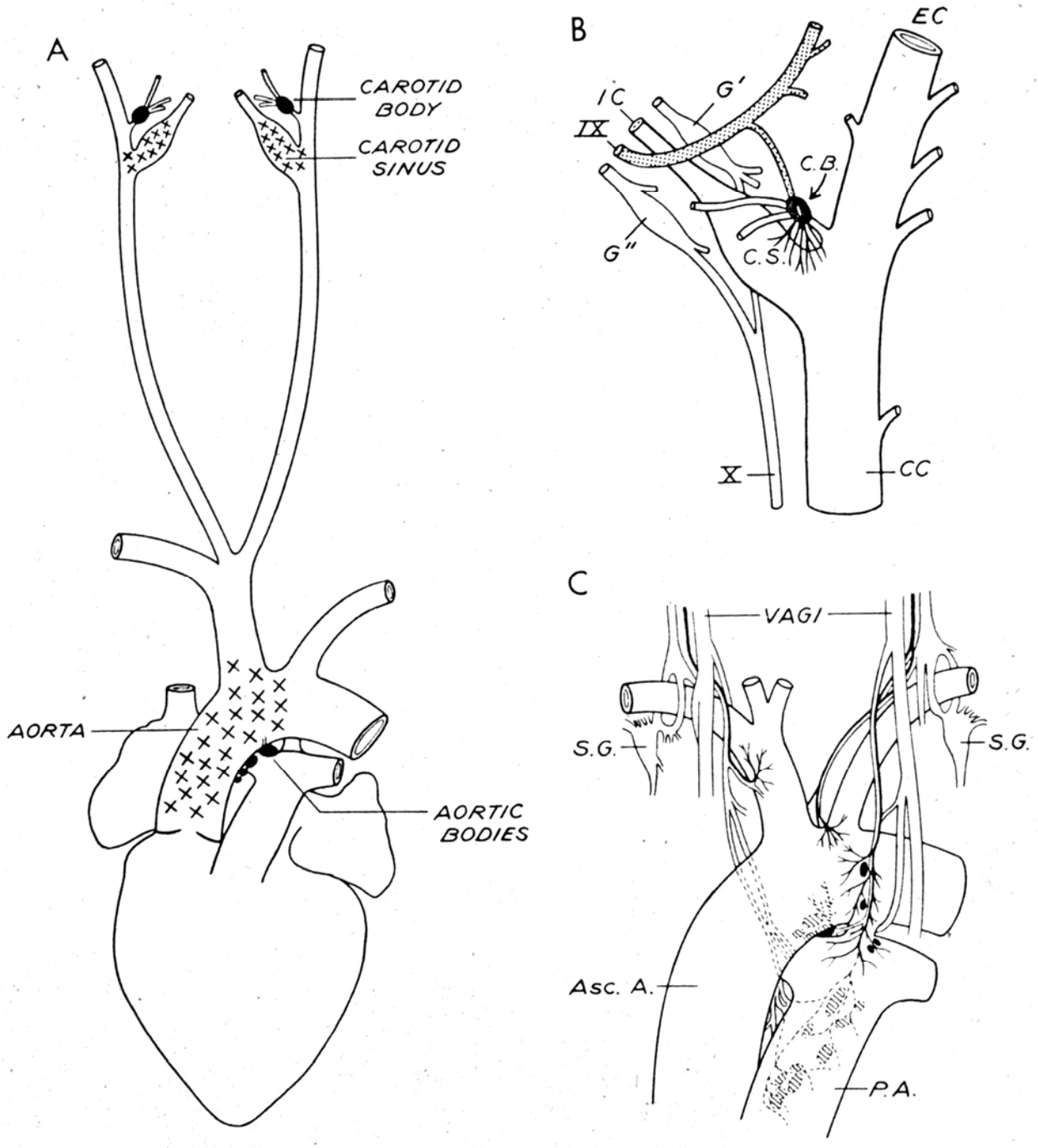

A
CAROTID BODY
CAROTID SINUS
AORTA
AORTIC BODIES
B
EC
IC
G'
IX
C.B.
G''
C.S.
X
CC
C
VAGI
S.G.
S.G.
Asc. A.
P.A.

TABLE 4-2.—O_2 TENSION OF ARTERIAL AND CAROTID BODY (END-CAPILLARY) BLOOD

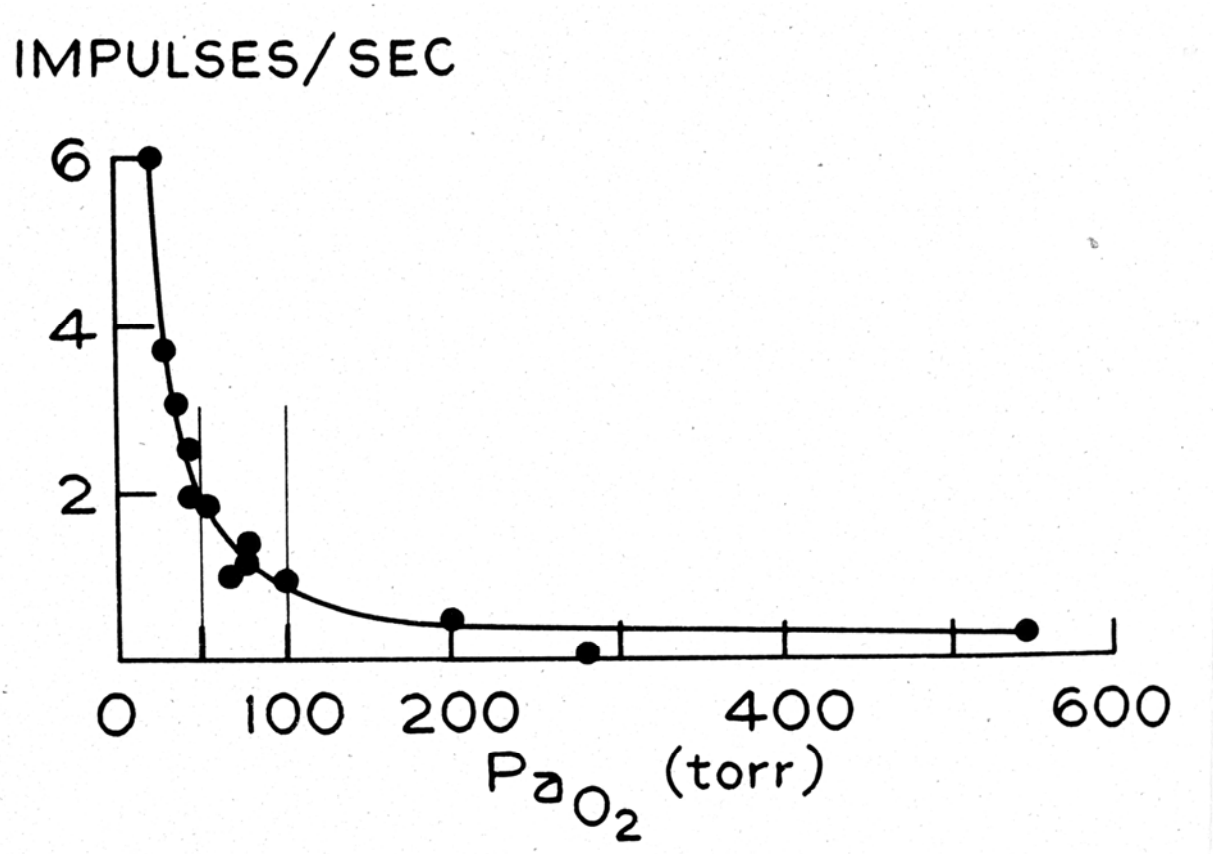
	Arterial Blood			Blood Flow/min to Carotid Body	O_2 Removed† (ml O_2/100 ml)	Carotid Body End-Capillary Blood			Increased Respiration Caused by Carotid Body Reflexes
	O_2 Saturation (%)	Po_2 (torr)	O_2 Content* (ml O_2/100 ml)			O_2 Content (ml O_2/100 ml)	O_2 Saturation (%)	Po_2 (torr)	
1. Normal‡ (15 gm Hb)	98.5	100	19.7 + 0.3 = 20.0	normal	0.5	19.5	96.0	88	No
2. Hypoxemia (15 gm Hb)	50.0	27	10.0 + 0.08 = 10.08	normal	0.5	9.58	47.5	25	Yes
3. Hypotension	98.5	100+	19.7 + 0.3 = 20.0	¼ normal	2.0	18.0	89.0	60	Slight
4. Anemia (50%) (7.5 gm Hb)	98.5	100	9.85 + 0.3 = 10.15	normal	0.5	9.65	94.5	80	No
5. Anemia (20%) (3 gm Hb)	98.5	100	3.94 + 0.3 = 4.24	normal	0.5	3.74	87.5	55	Slight
6. Saline (no Hb)		150	0.45	2 × normal	0.25	0.2		66	No
7. HbCO (7.5 gm active Hb)	98.5 (50%)§	99+	9.85 + 0.3 = 10.15	normal	0.5	9.65	94.5	80 – 50	No

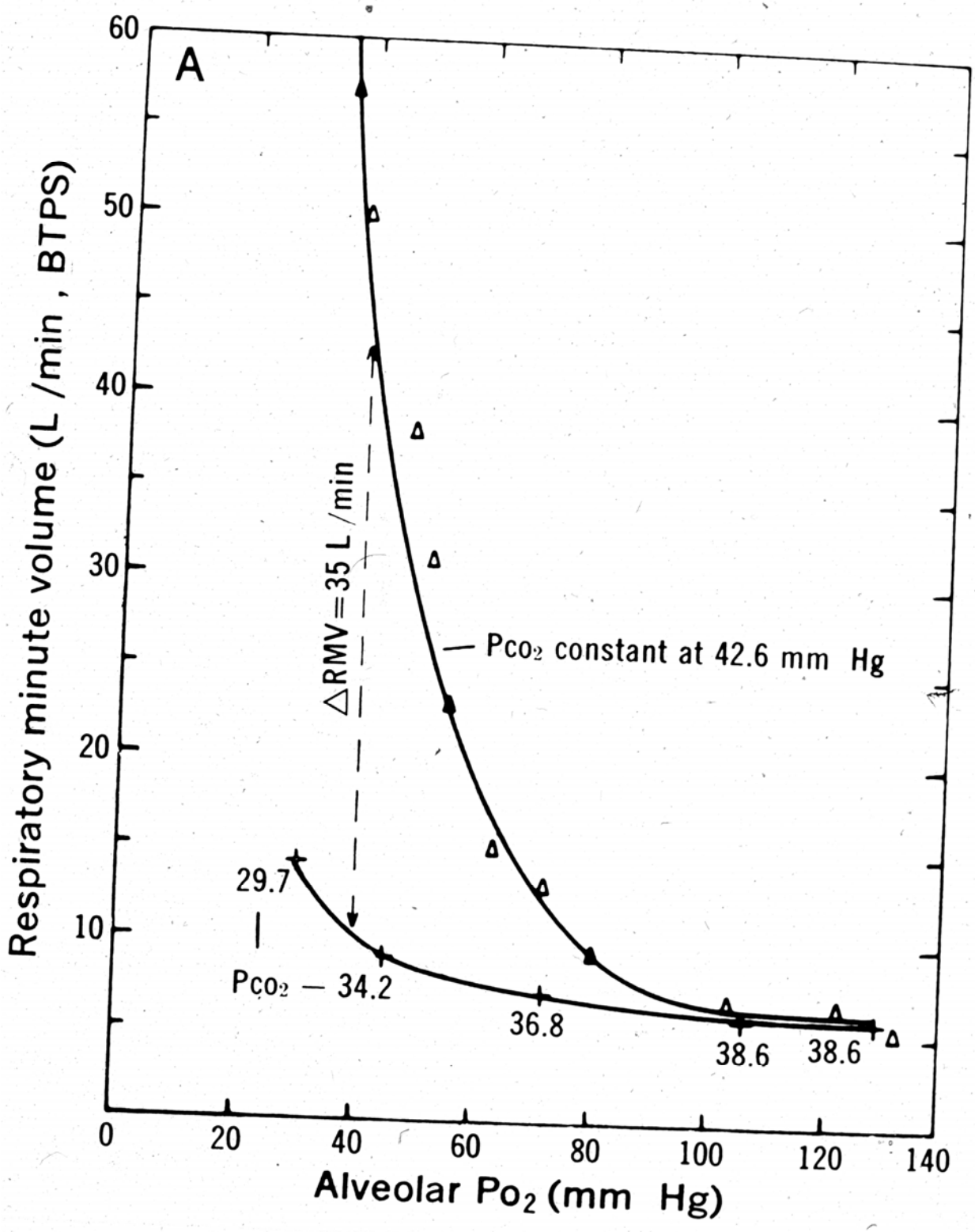
*The O_2 content is calculated as the sum of O_2 combined with Hb and O_2 dissolved in the blood. This calculation is explained in Chapter 14 and Figure 14-1.

†There is no measurable difference between O_2 in arterial blood entering the carotid body and venous blood leaving it, when blood flow is rapid. The value in this column is computed from the measured difference of 2 ml O_2/100 ml blood when blood flow is deliberately reduced to ¼ normal. This may be a high value because of increased chemoreceptor activity during ischemia.

‡Normal blood is assumed to contain 15 gm Hb/100 ml. Each gm can combine with 1.34 ml O_2; the O_2 capacity of Hb of 100 ml of this blood is 20 ml (Fig. 14-1).

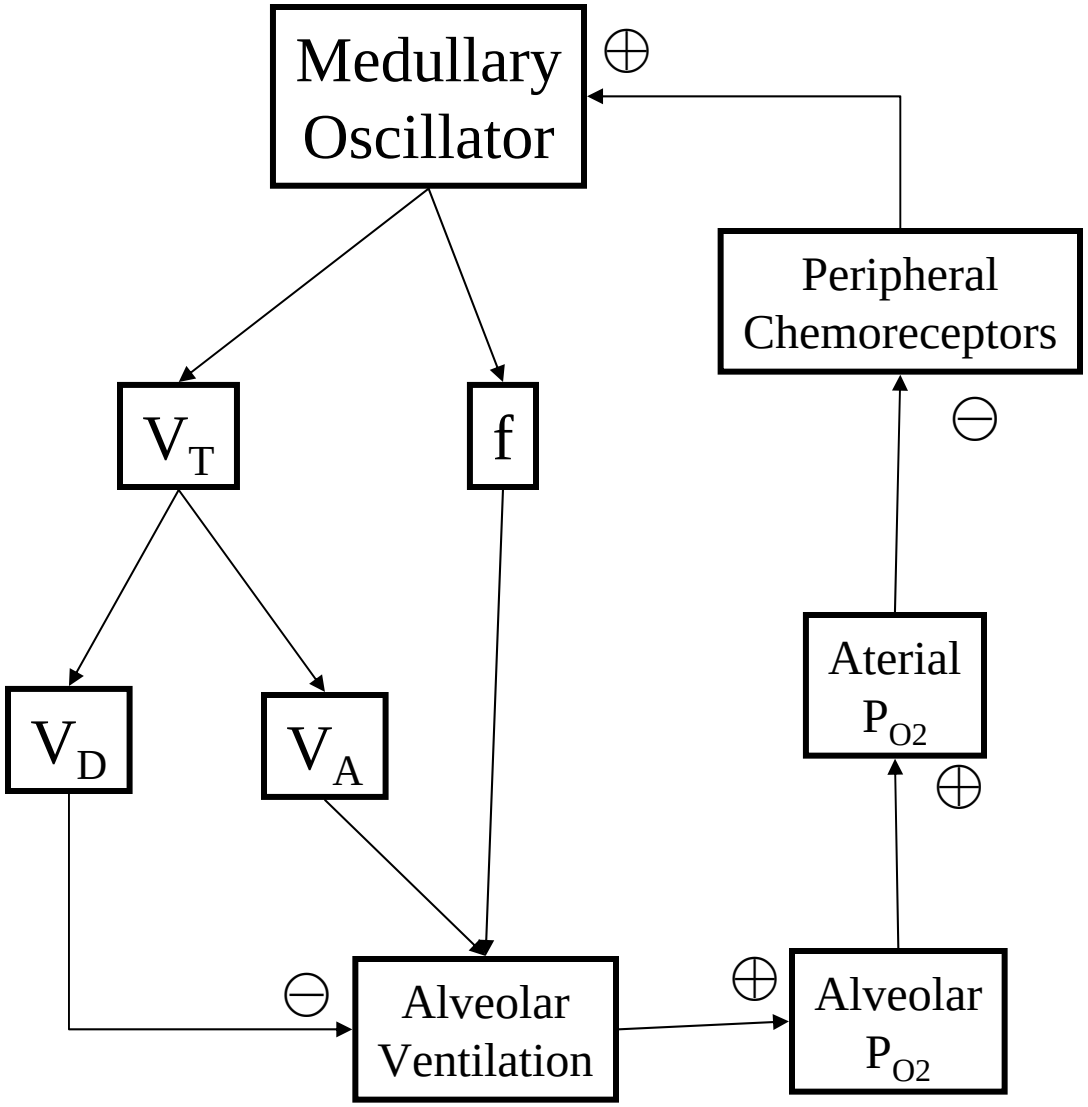
§Fifty percent of total Hb is active and is 98.5% saturated with O_2.

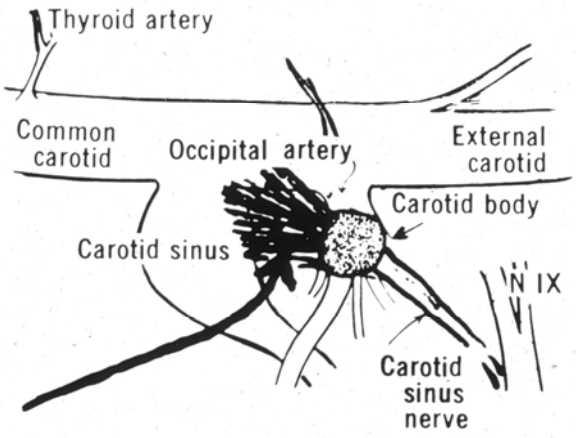

IMPULSES/SEC
6
4
2
0
100
200
400
600
$P_{a_{O_2}}$ (torr)

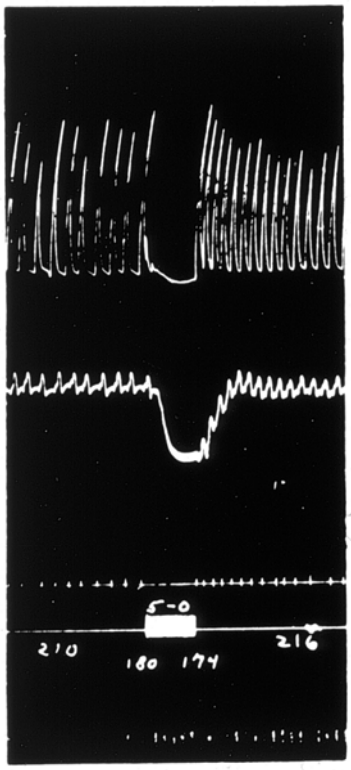

A
Respiratory minute volume (L /min , BTPS)
Alveolar Po2 (mm Hg)
ΔRMV=35 L /min
Pco2 constant at 42.6 mm Hg
29.7
Pco2 — 34.2
36.8
38.6
38.6
60
50
40
30
20
10
0
20
40
60
80
100
120
140

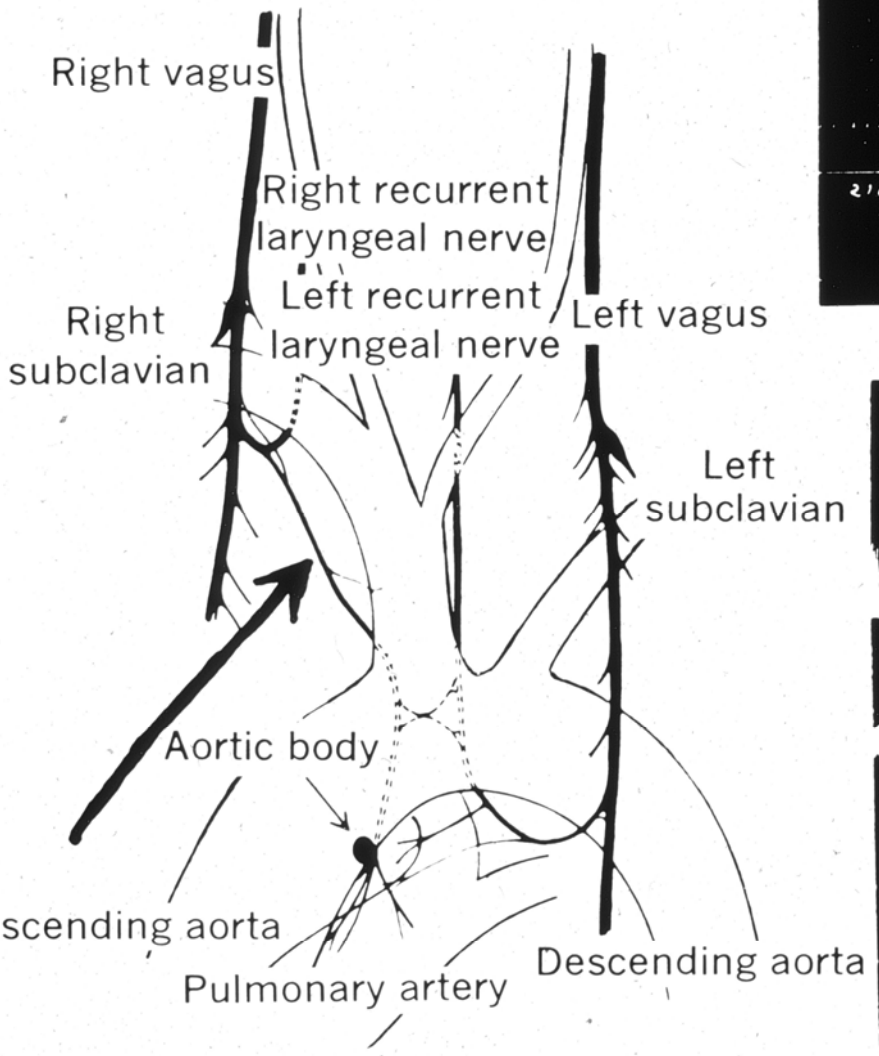
Hypoxic Response Index

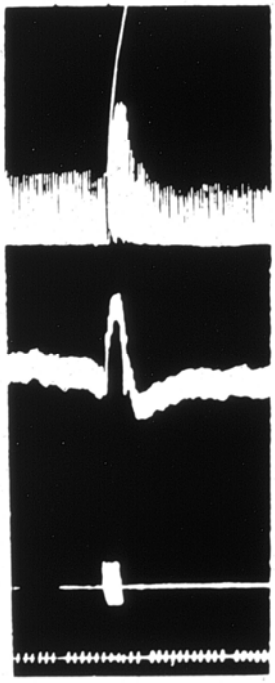
ΔV_{E40}= Isocapnic increase in V_E when P_{AO2} is reduced to 40 mmHg

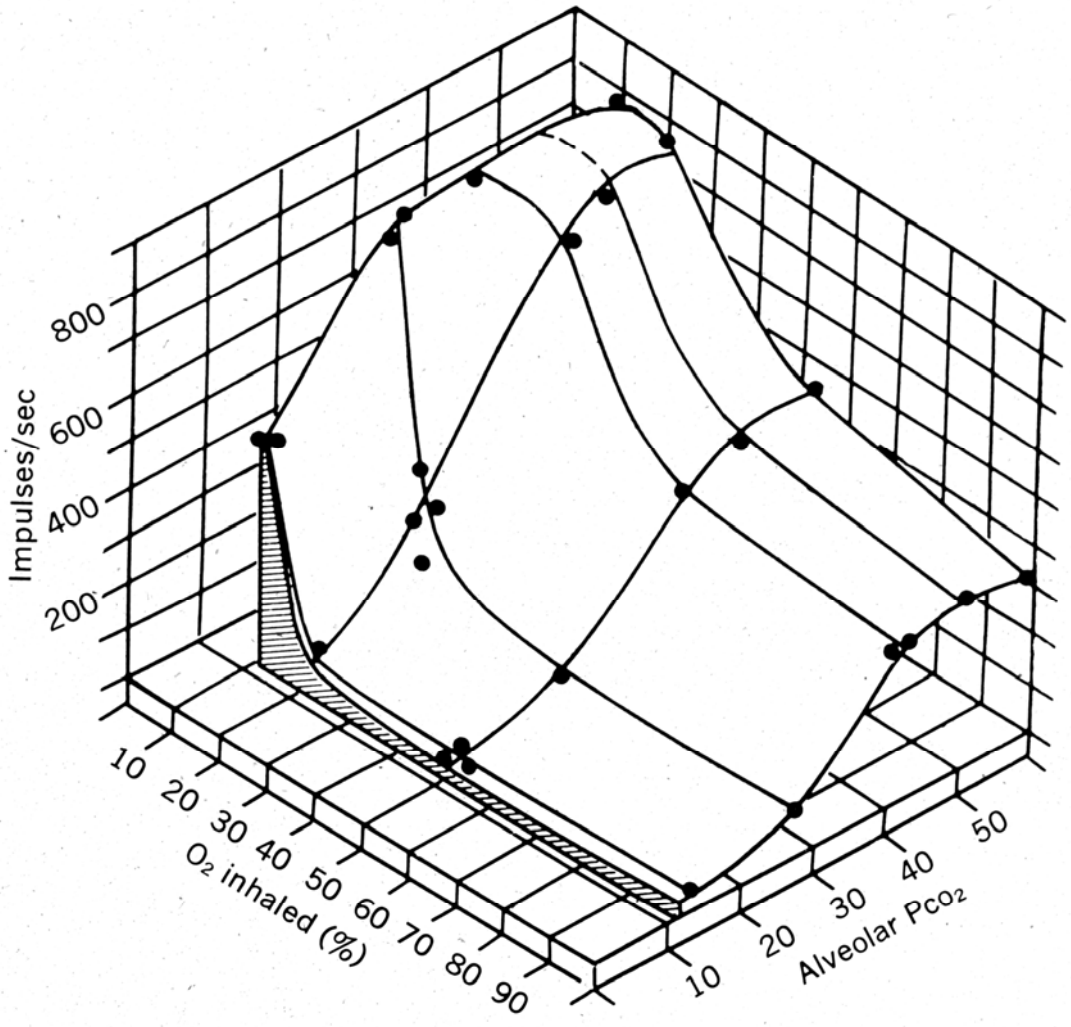

Medullary Oscillator
⊕
Peripheral Chemoreceptors
⊖
V_T
f
Aterial P_{O2}
⊕
V_D
V_A
⊖
Alveolar Ventilation
⊕
Alveolar P_{O2}


Thyroid artery
Common carotid
Occipital artery
External carotid
Carotid body
Carotid sinus
IX
Carotid sinus nerve


5-0
210
180
174
216


Right vagus
Right recurrent laryngeal nerve
Left recurrent laryngeal nerve
Left vagus
Right subclavian
Left subclavian
Aortic body
Ascending aorta
Pulmonary artery
Descending aorta




Impulses/sec
800
600
400
200
10 20 30 40 50 60 70 80 90
O_2 inhaled (%)
10 20 30 40 50
Alveolar Pco_2

$$H_2O + CO_2 \underset{\text{(lungs)}}{\overset{\text{C.A.}}{\rightleftharpoons}} H_2CO_3 \rightleftharpoons H^+ + HCO_3^- \quad \text{(kidneys)}$$

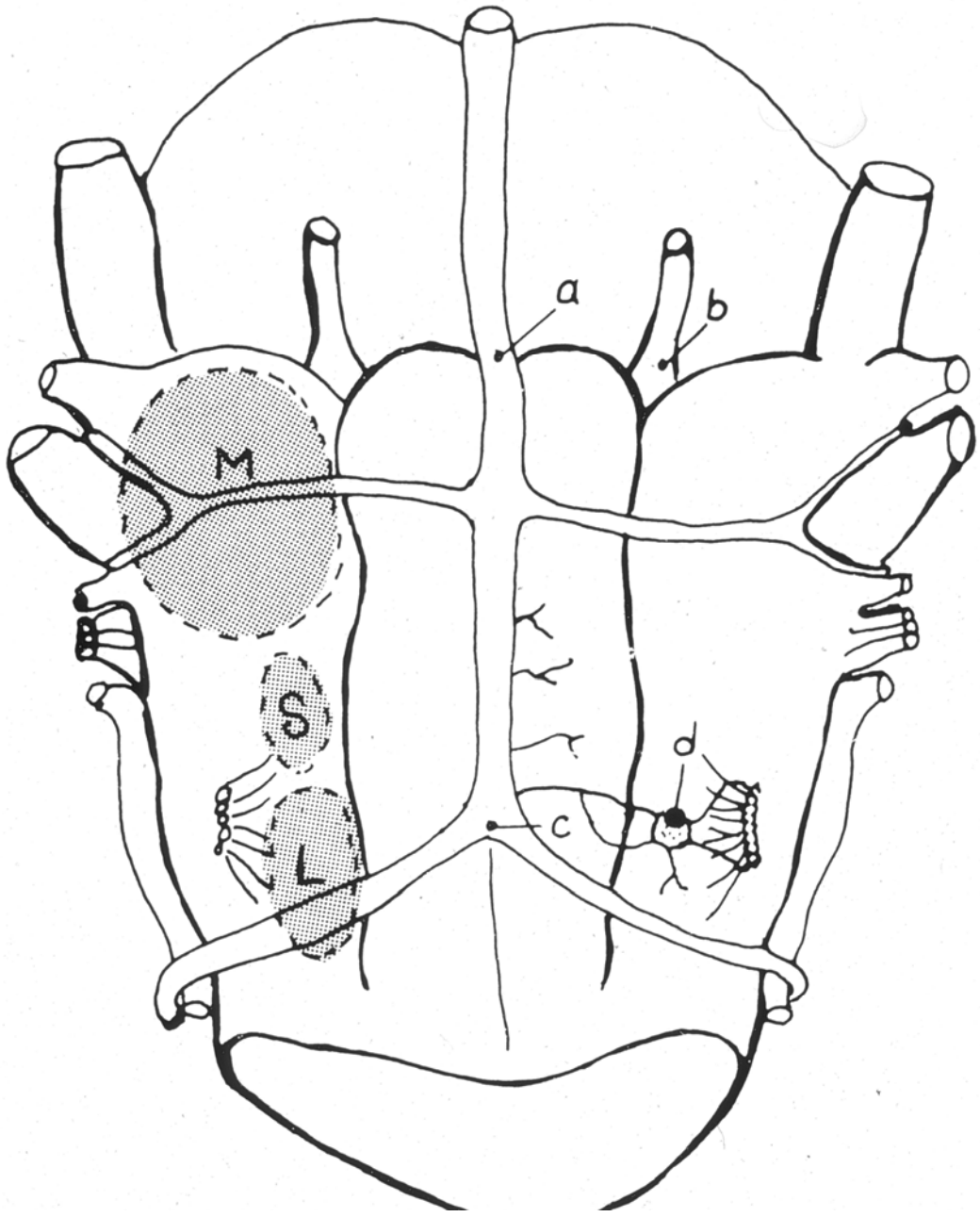
Henderson Hasselbalch Equation

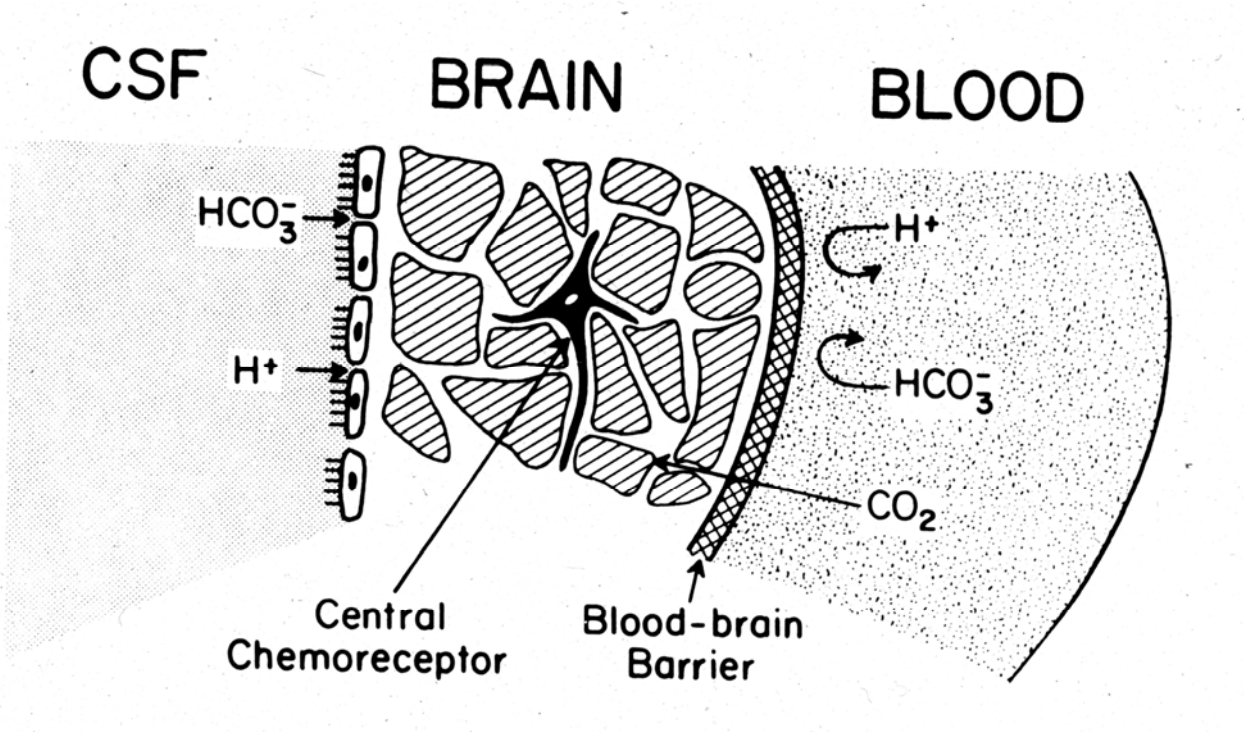
$$pH = 6.1 + \log \frac{HCO_3^-}{0.03 * P_{CO_2}}$$

$$7.4 = 6.1 + \log \frac{24m\ Eq/L}{1.24mM\ CO_2/L} \qquad \frac{20}{1}$$

Acidosis: $pH < 7.4$

Alkalosis: $pH > 7.4$


a
b
M
S
L
d
c
V
VI
VII
VIII
IX
X
XI
XII


CSF
BRAIN
BLOOD
HCO_3^-
H^+
H^+
HCO_3^-
CO_2
Central Chemoreceptor
Blood-brain Barrier

CO_2 Sensitivity

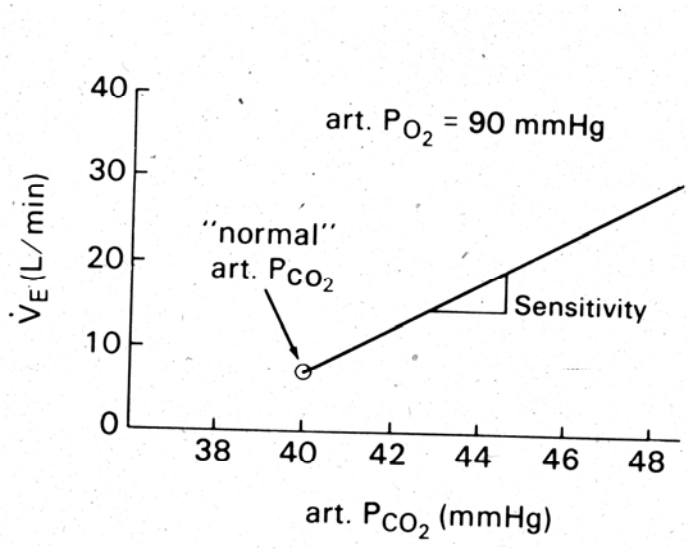
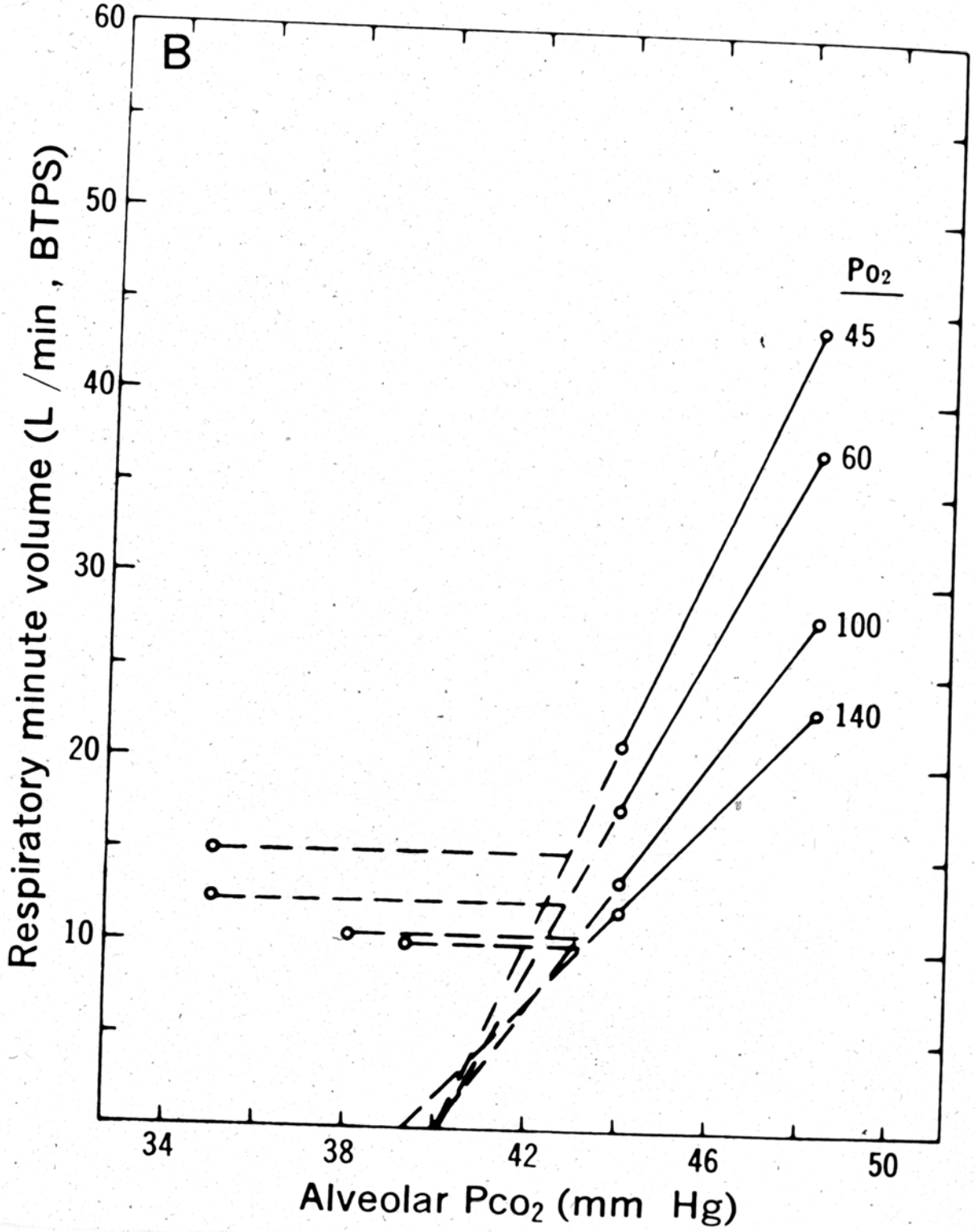
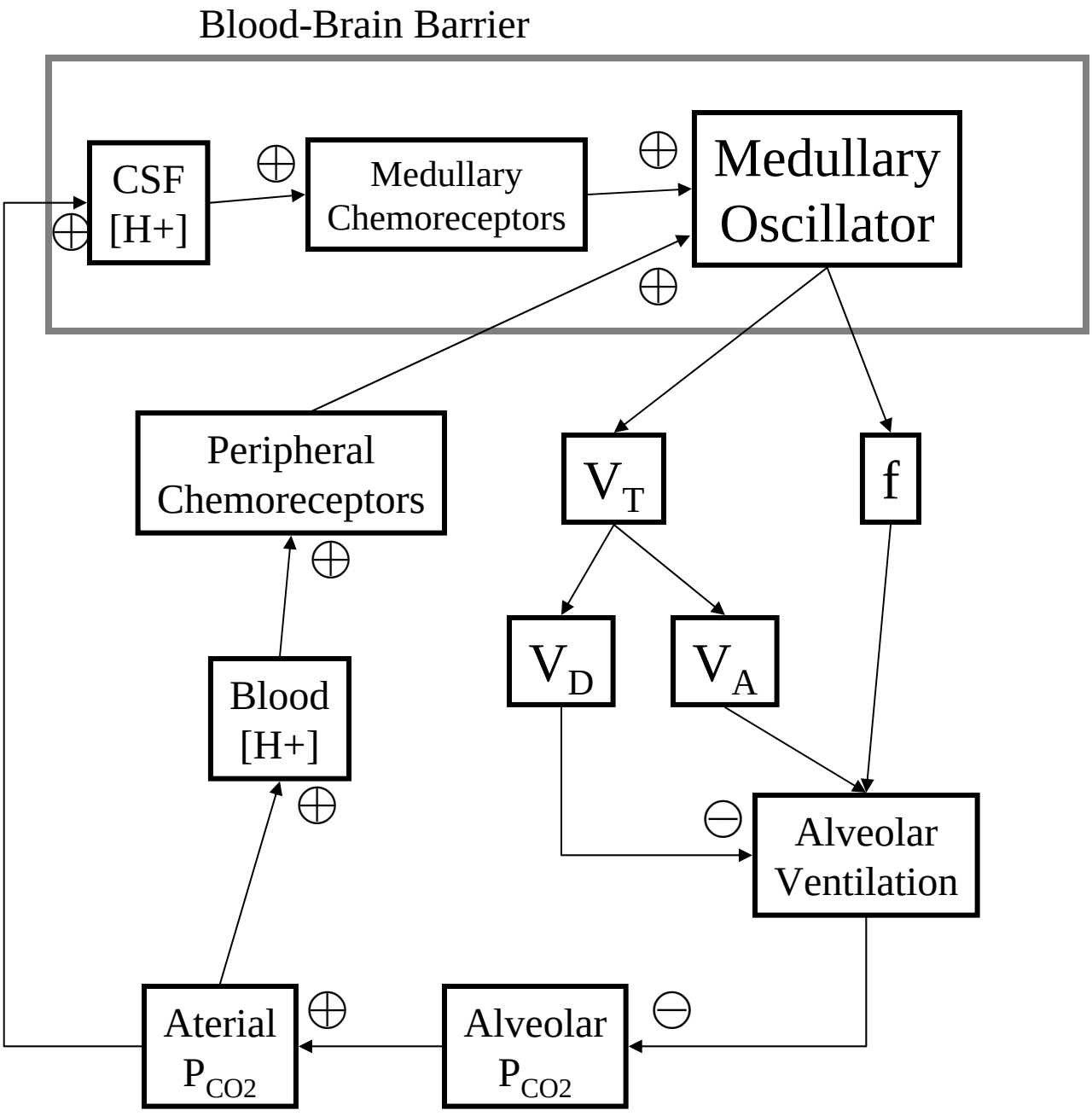
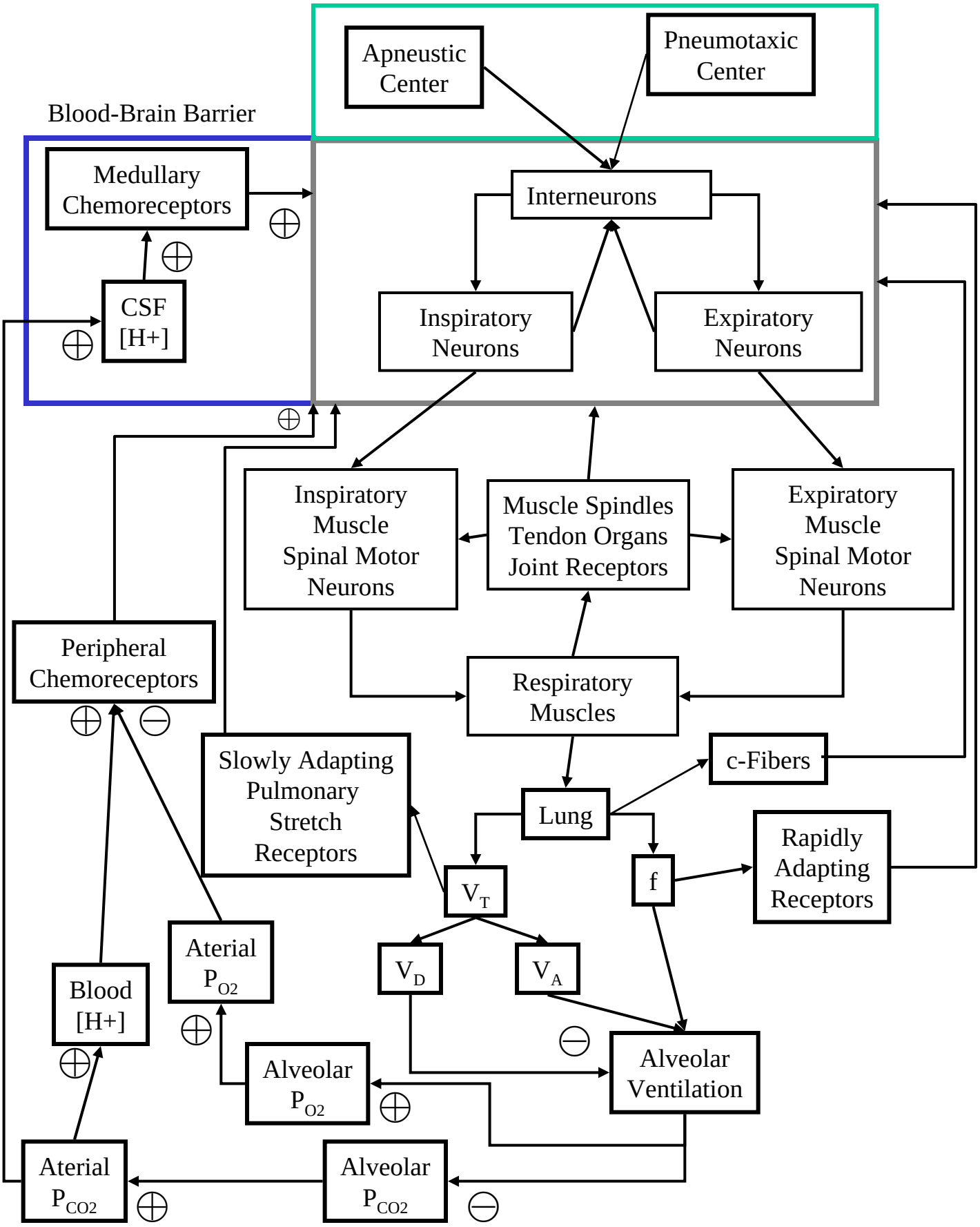


Figure 7. A stimulus-response curve of the respiratory control system for the CO_2 stimulus. Art. P_{CO2} is increased above the "normal" value while art. P_{O2} is held at the "normal" value.


B
60
50
40
30
20
10
Respiratory minute volume (L /min , BTPS)
34
38
42
46
50
Alveolar Pco2 (mm Hg)
Po2
45
60
100
140


Blood-Brain Barrier
CSF
[H+]
Medullary
Chemoreceptors
Medullary
Oscillator
Peripheral
Chemoreceptors
V_T
f
V_D
V_A
Blood
[H+]
Alveolar
Ventilation
Aterial
P_{CO2}
Alveolar
P_{CO2}


Apneustic Center
Pneumotaxic Center
Blood-Brain Barrier
Medullary Chemoreceptors
Interneurons
CSF [H+]
Inspiratory Neurons
Expiratory Neurons
Inspiratory Muscle Spinal Motor Neurons
Muscle Spindles Tendon Organs Joint Receptors
Expiratory Muscle Spinal Motor Neurons
Peripheral Chemoreceptors
Respiratory Muscles
Slowly Adapting Pulmonary Stretch Receptors
c-Fibers
Lung
Rapidly Adapting Receptors
f
V_T
V_D
V_A
Aterial P_{O2}
Blood [H+]
Alveolar P_{O2}
Alveolar Ventilation
Aterial P_{CO2}
Alveolar P_{CO2}