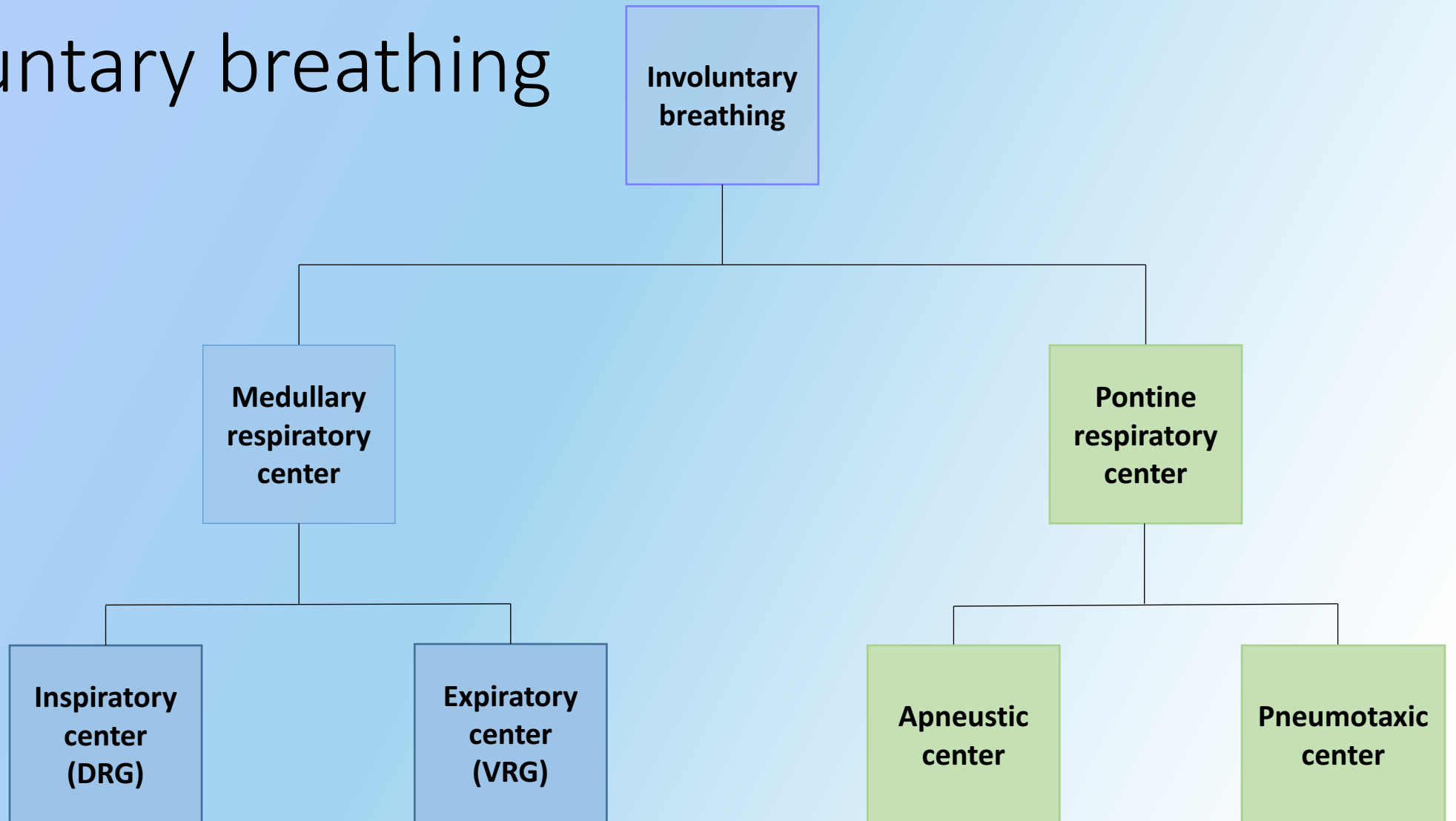


Control of Breathing

Alexandra Vedeler

Involuntary breathing



Pneumotaxic center

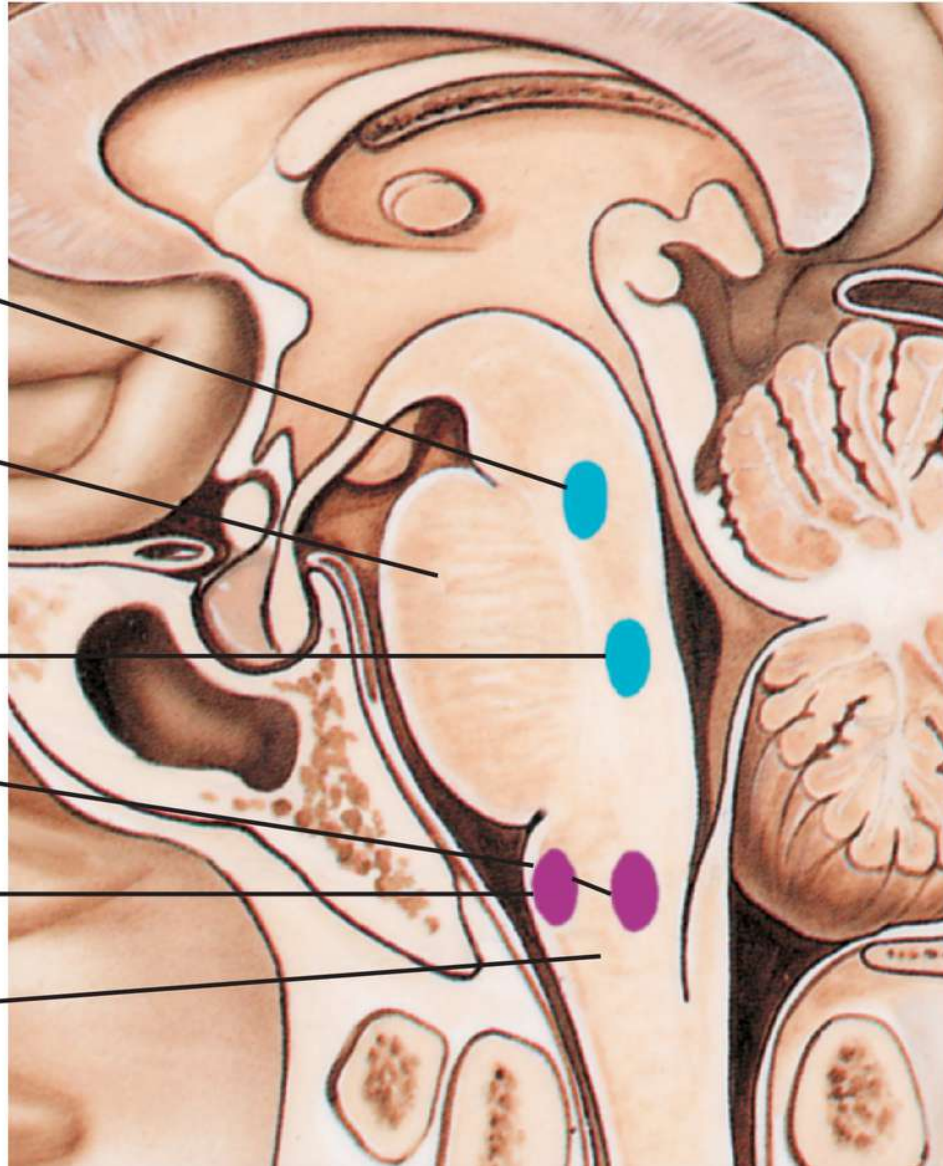
Pons

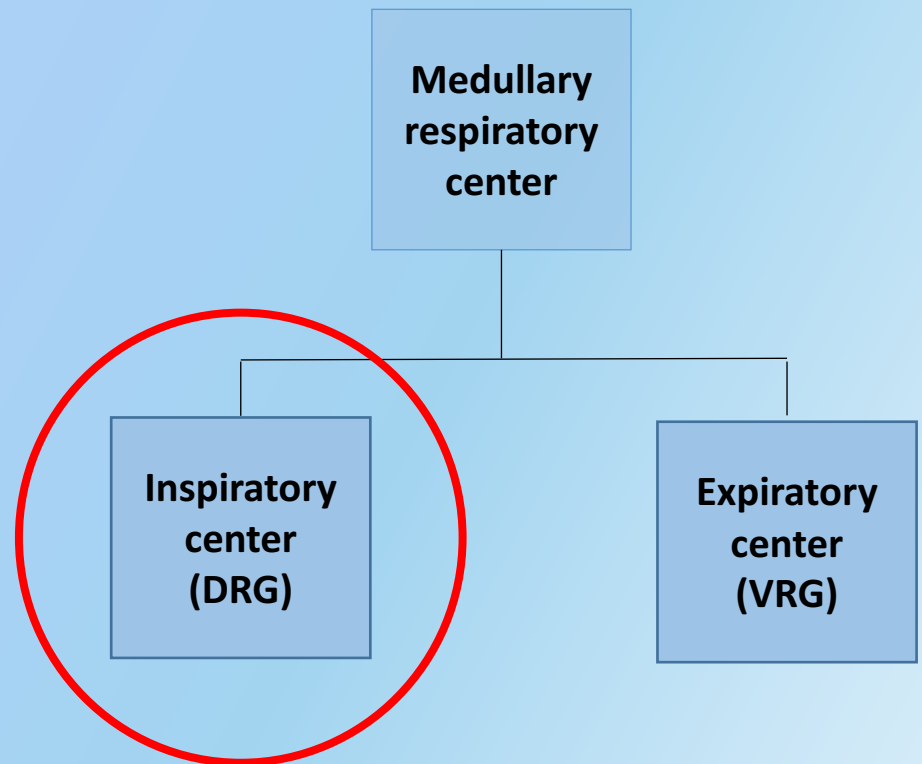
Apneustic center

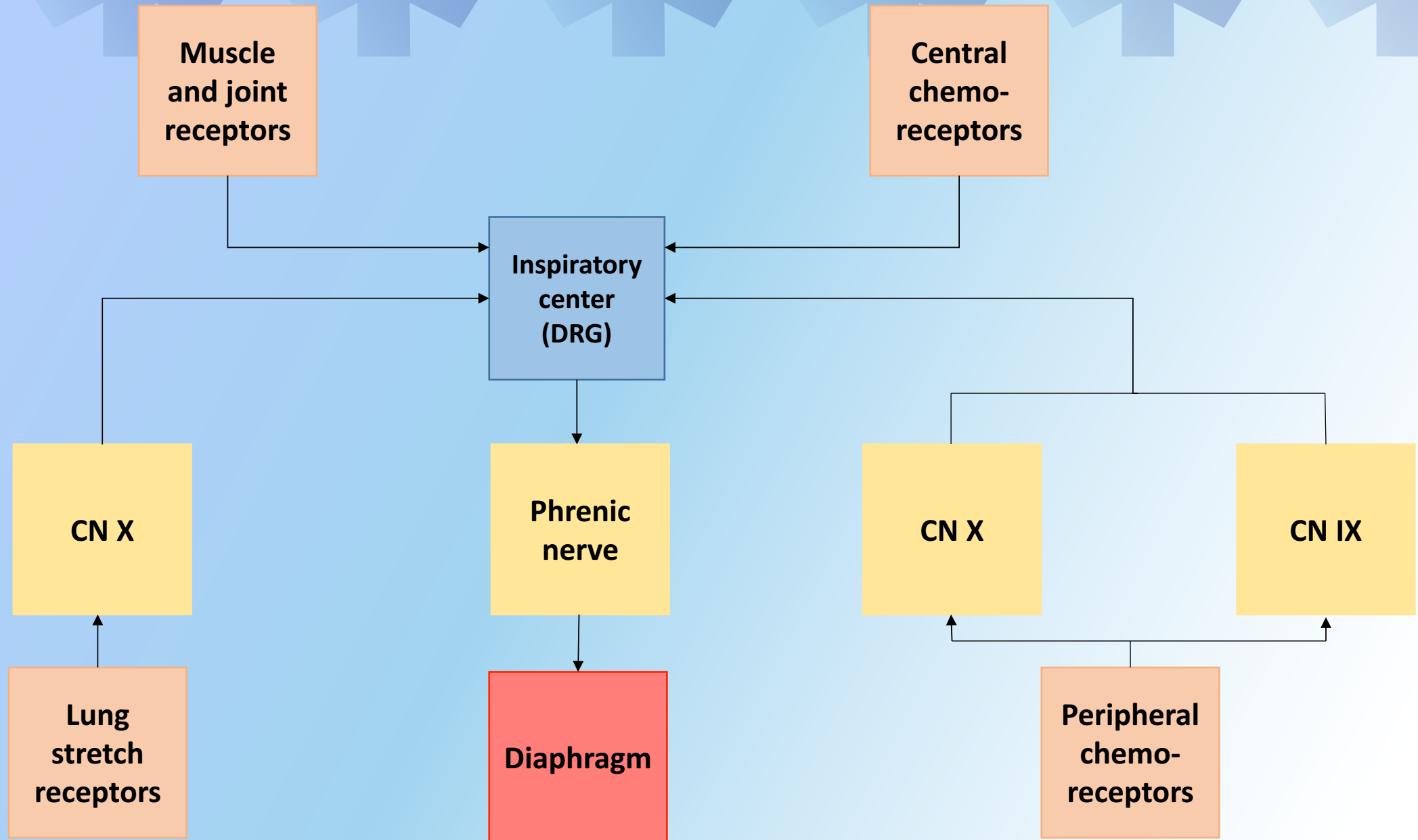
Inspiratory area

Expiratory area

Medulla

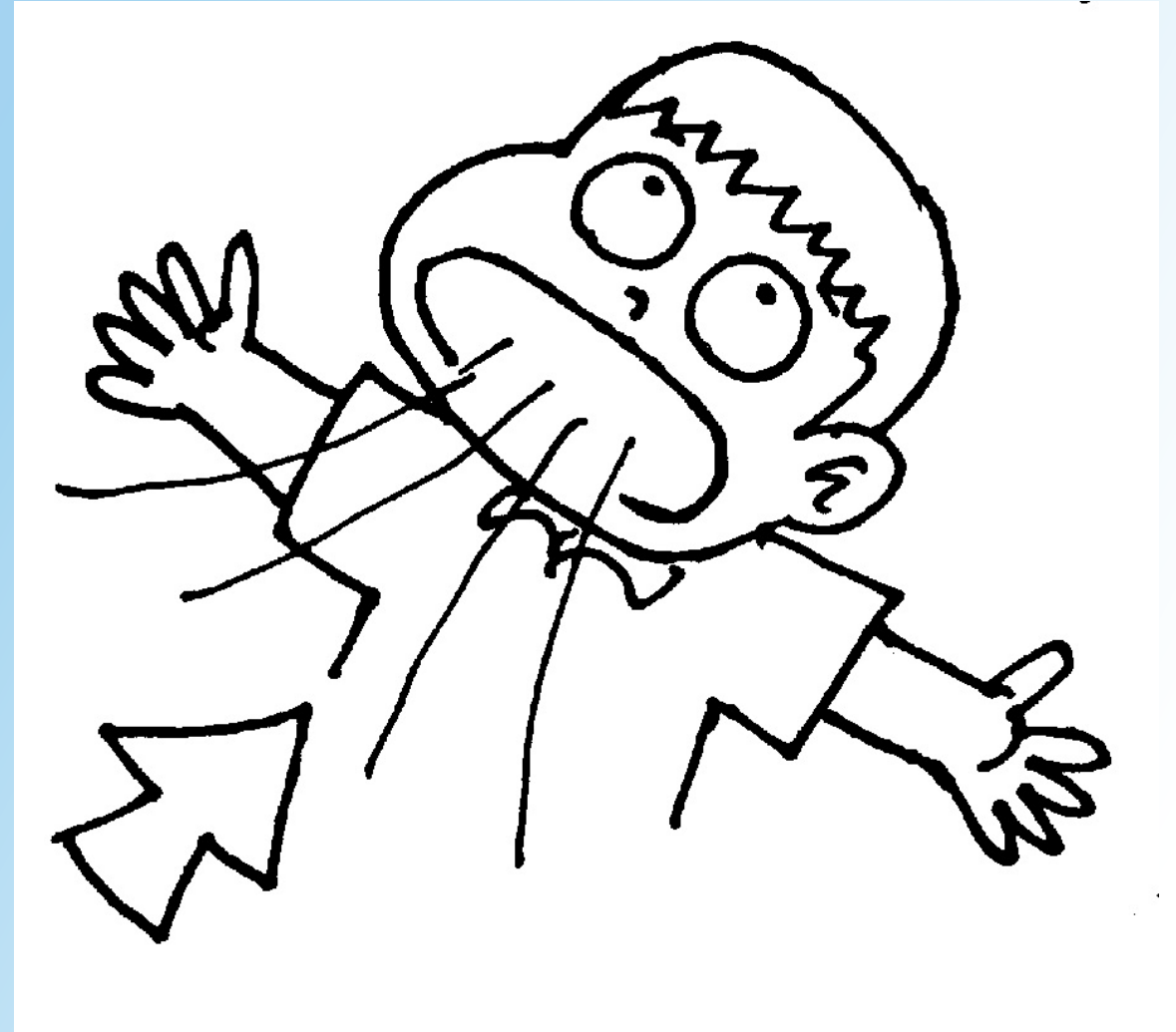


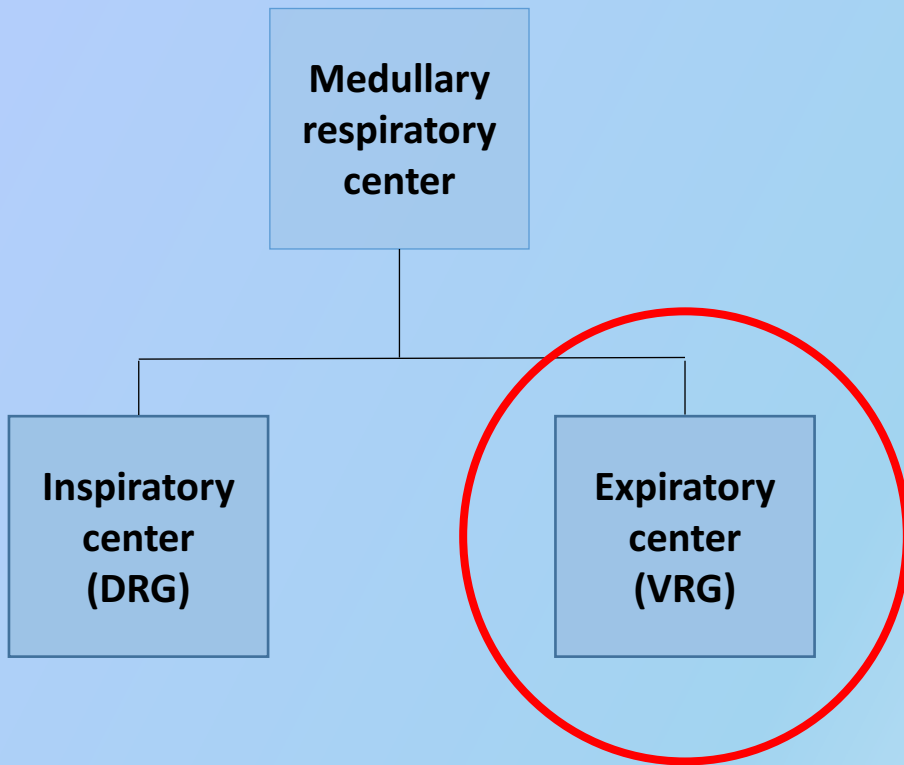




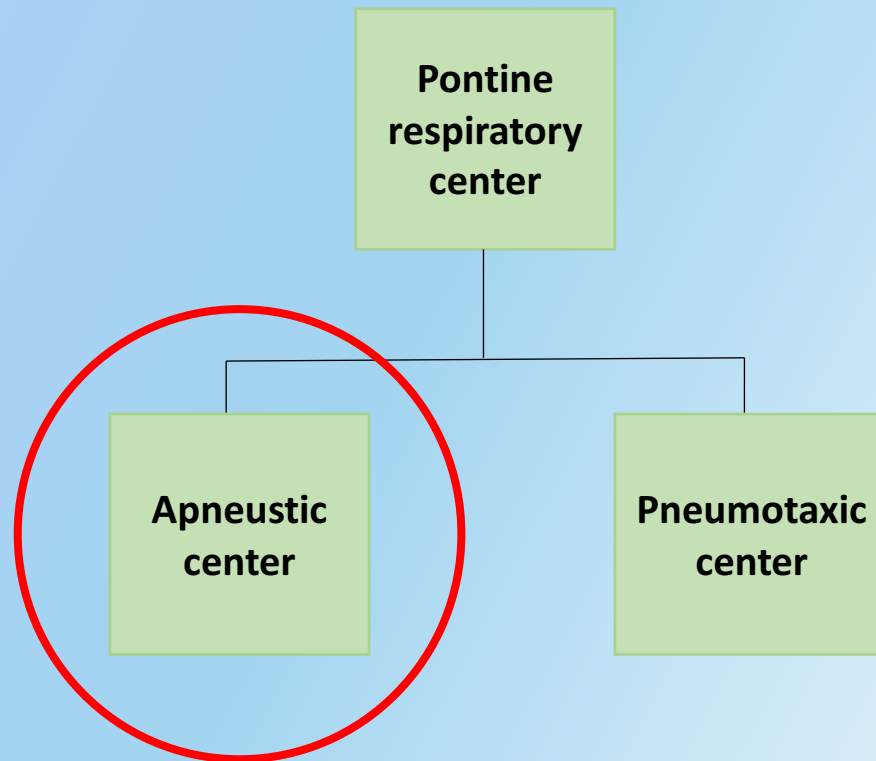
→ Inspiration

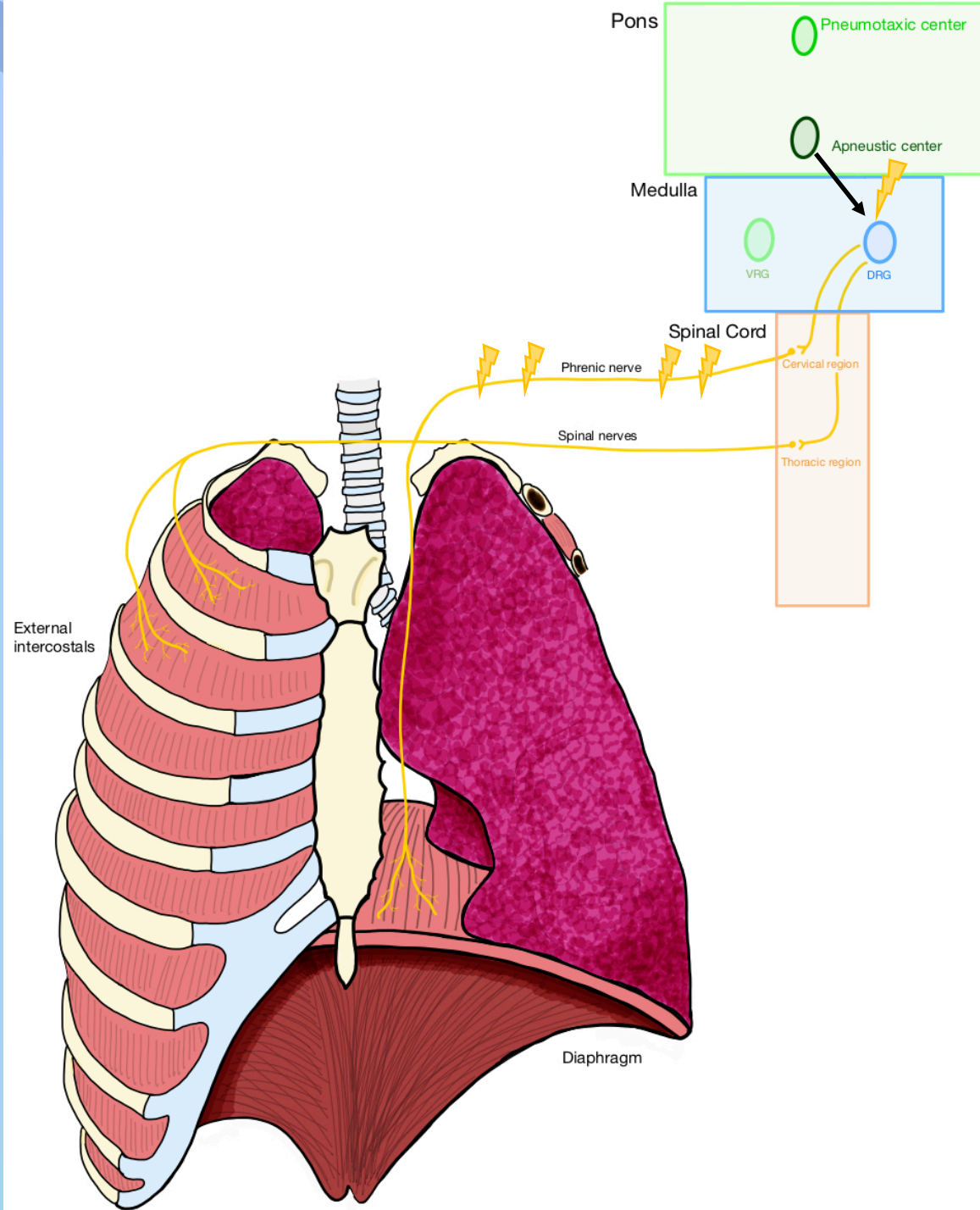
- DRG – Dorsal Respiratory Group
- What turns off inspiration?
 - Hering-Breuer reflex
 - Pneumotaxic center

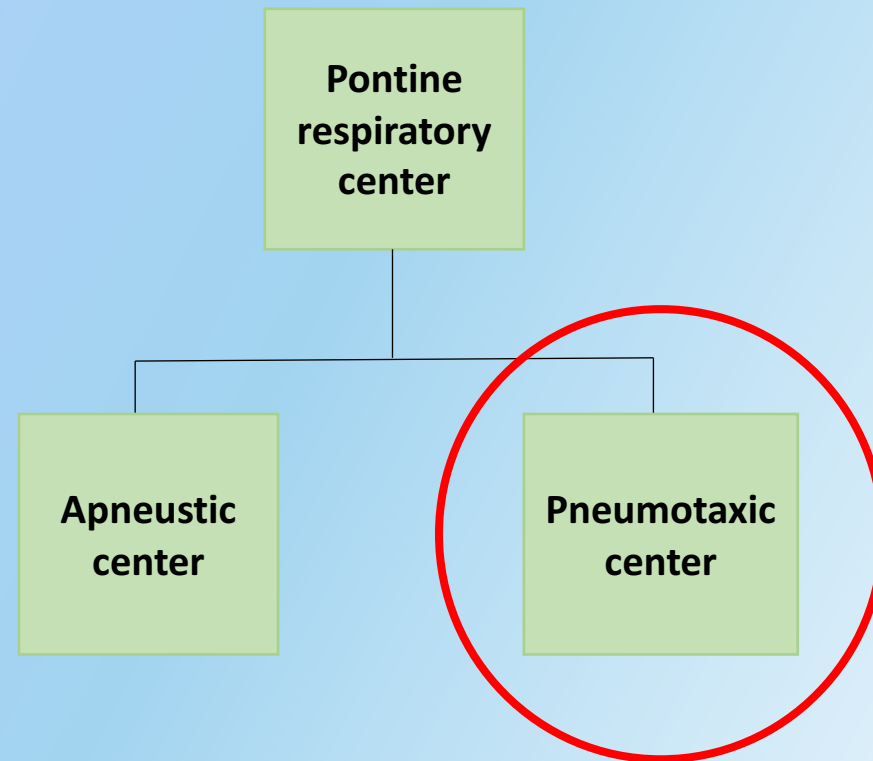




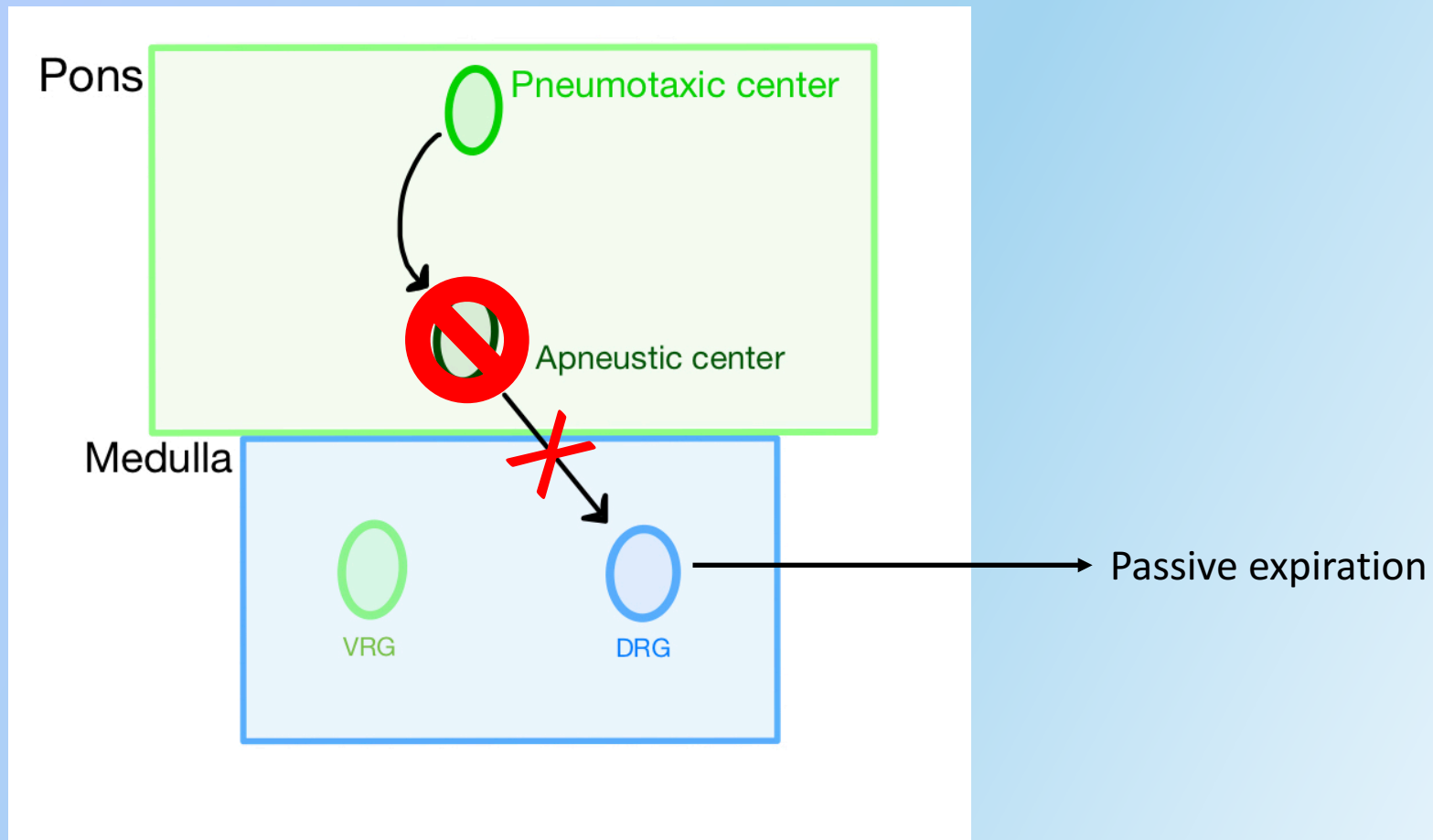
- VRG = Ventral Respiratory Group
- Pre-Bötzinger complex
 - Contains **both** inspiratory and expiratory neurons
 - Rhythmic respiration
- **INACTIVE** during normal, quiet breathing
- **ACTIVE** during forceful breathing







Pneumotaxic center






Clinical correlation

A 27 year old male presents to the emergency ward after being hit in the back of the head during a bar fight. As you greet him you notice he is gasping for breath. During physical examination he presents with prolonged inspiration followed by a brief and insufficient expiration.

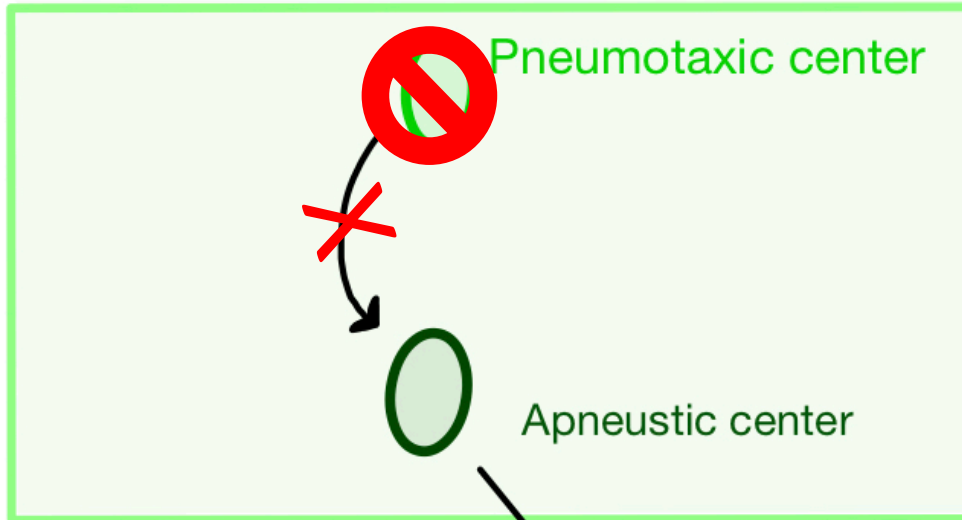
What part of the brain is damaged?



A 27 year old male presents to the emergency ward after being hit in the **back of the head** during a bar fight. As you greet him you notice he is gasping for breath. During physical examination he presents with **prolonged inspiration followed by a brief and insufficient expiration.**

What part of the brain is damaged? **Pneumotaxic center**

Pons

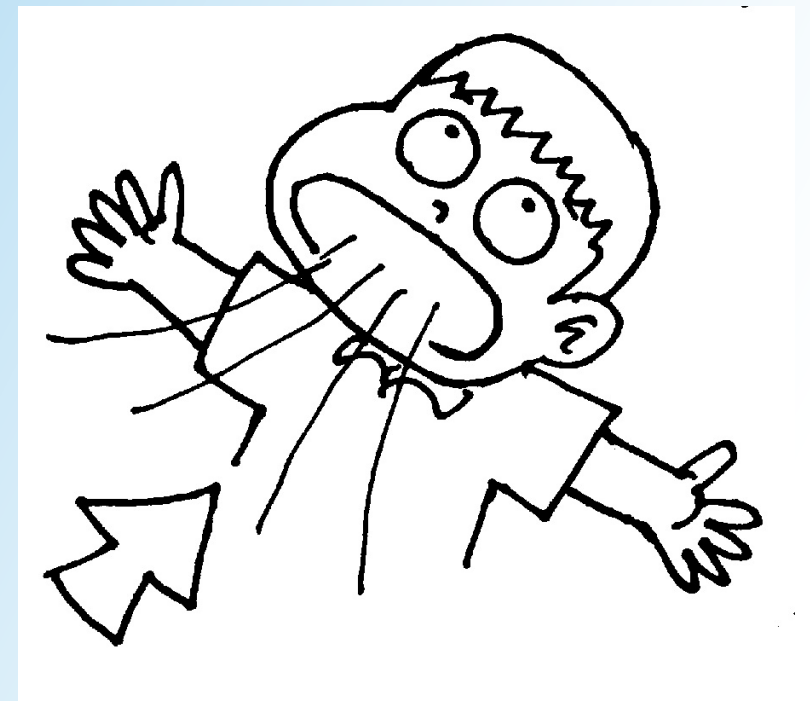


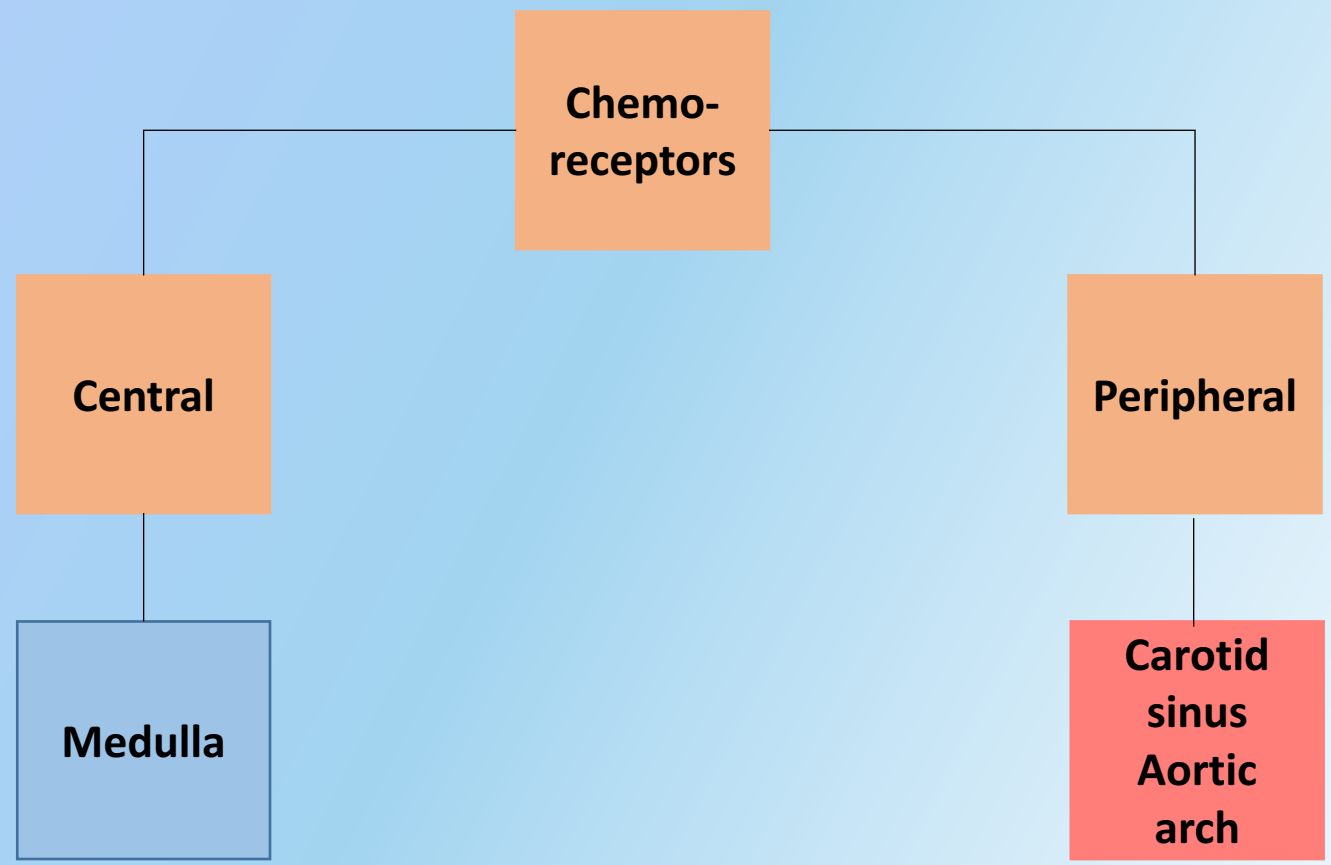
Medulla

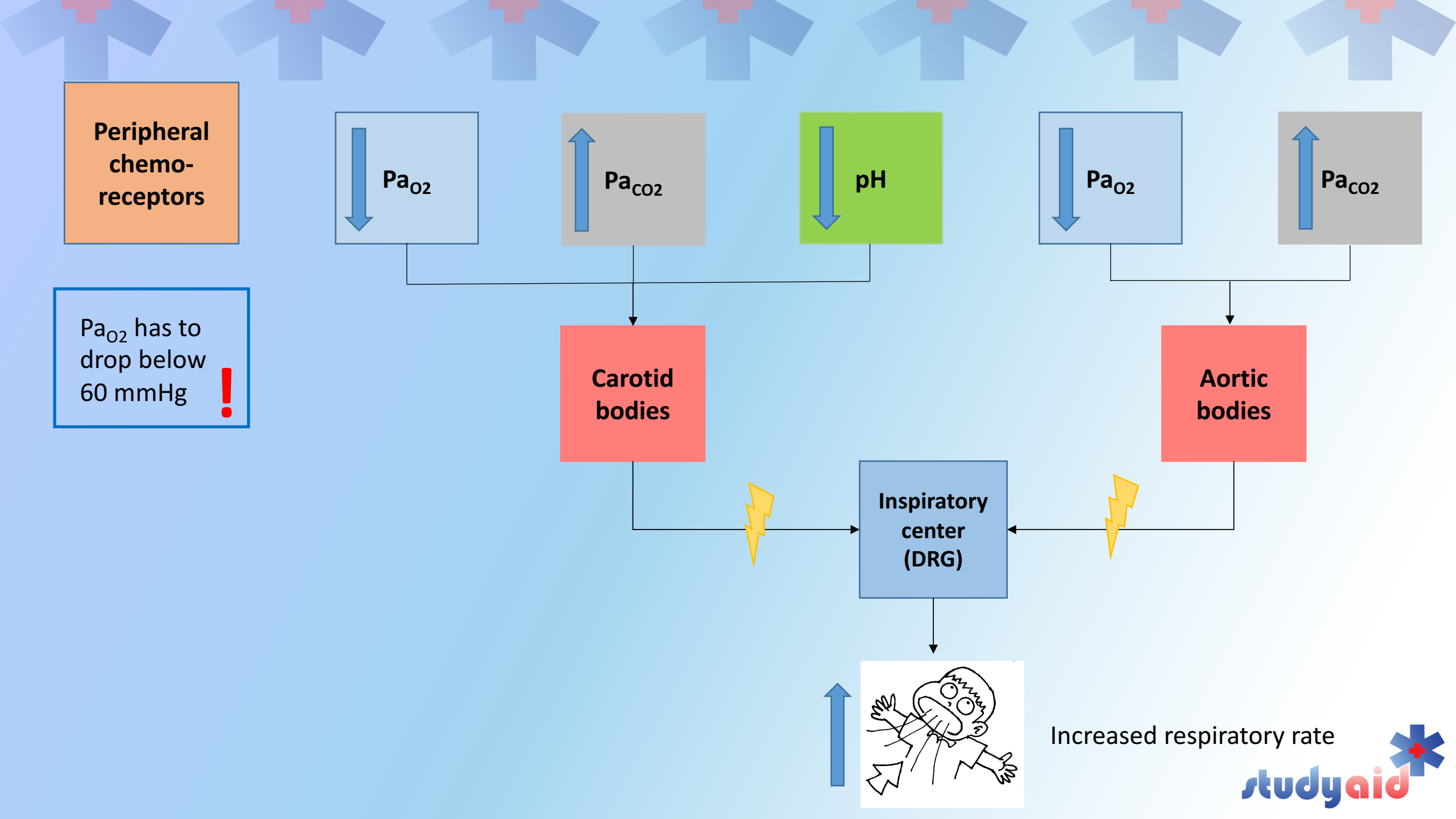


Apneusis

Continuous inspiration







Peripheral chemo-receptors

Pa_{O_2} ↓

Pa_{CO_2} ↑

pH ↓

Pa_{O_2} ↓

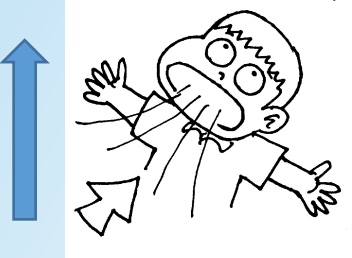
Pa_{CO_2} ↑

Pa_{O_2} has to drop below 60 mmHg !

Carotid bodies

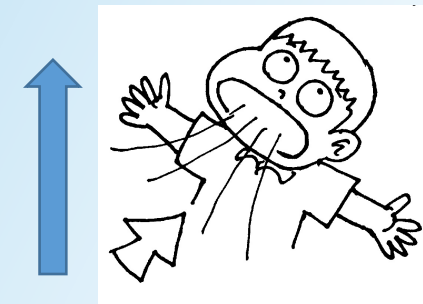
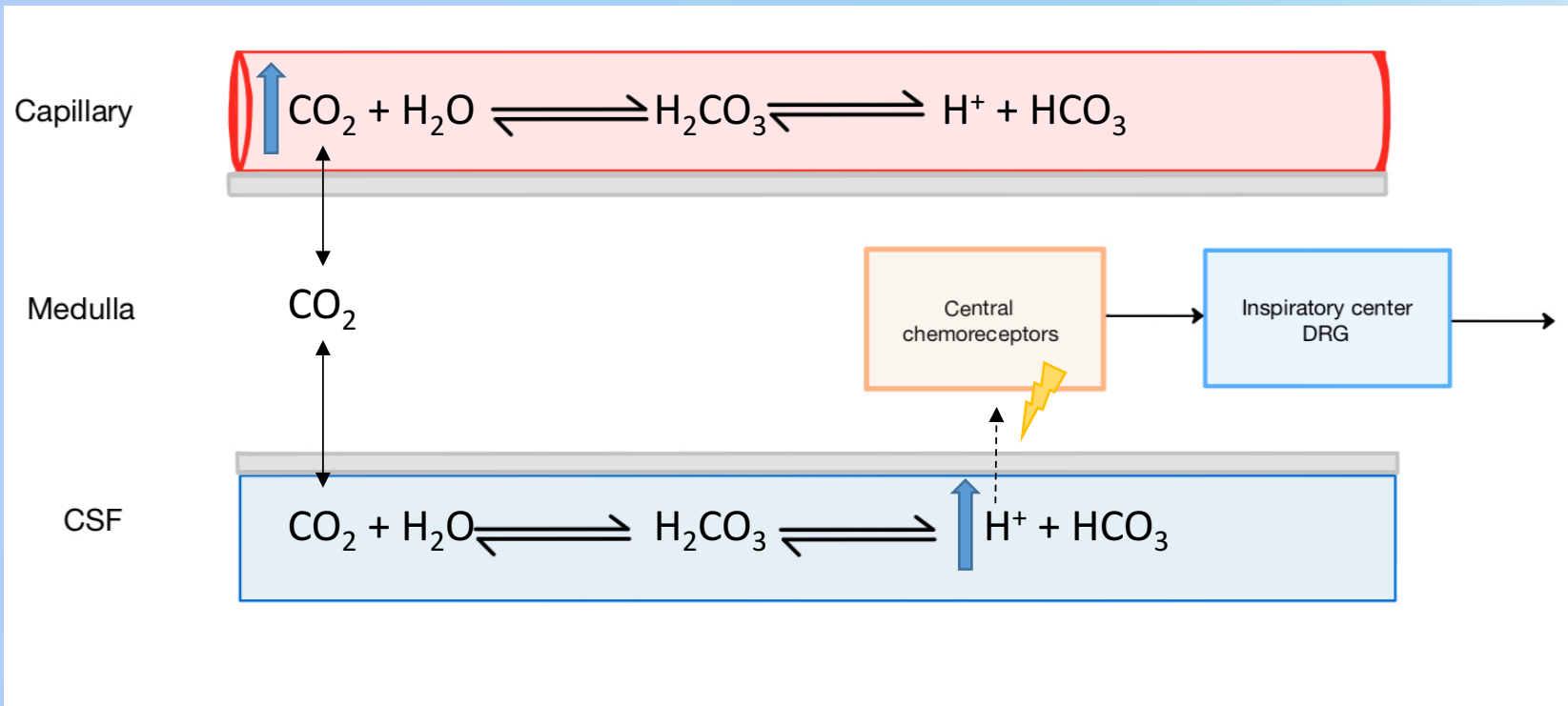
Aortic bodies

Inspiratory center (DRG)



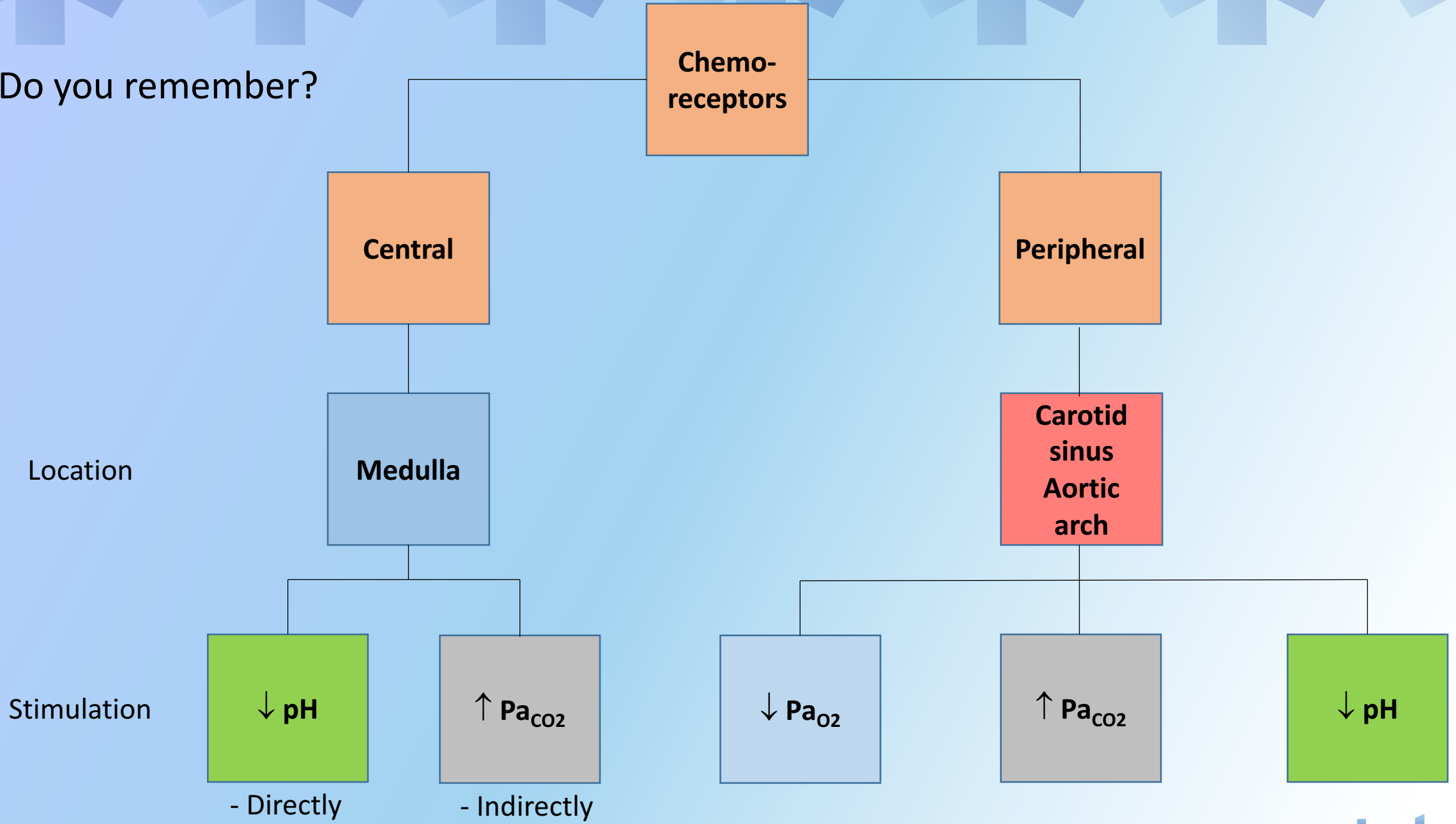
Increased respiratory rate

Central chemo-receptors





Do you remember?



Stimulation

↓ pH

- Directly

↑ Pa_{CO2}

- Indirectly

↓ Pa_{O2}

↑ Pa_{CO2}

↓ pH

	Lung stretch receptors	Joint and muscle receptors	Irritant receptors	Juxtacapillary receptors
Type	Mechanoreceptor	Mechanoreceptor	Rapidly adapting receptors	Sensory nerve endings
Location	Airway smooth muscle	Joints and muscles	Between airway epithelial cells	Alveolar walls
Stimulation	Distension of the lungs	Movement of limbs during exercise	Noxious chemicals and particles	- ↑ blood volume - ↑ interstitial fluid volume
Effect on respiratory rate	↓	↑	↑	↑
Reflexes	Hering-Breuer reflex		Coughing reflex	

Voluntary breathing

Location: Cerebral cortex

↑ Respiratory rate

↓ Respiratory rate

Hyper-ventilation

Hypo-ventilation

P_{aCO_2}

P_{aCO_2}

P_{aO_2}

